VOL. XIII Nº 1

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MECCANO MAGAZINE

CONSTRUCTING THE PANAMA CANAL (See page 2)

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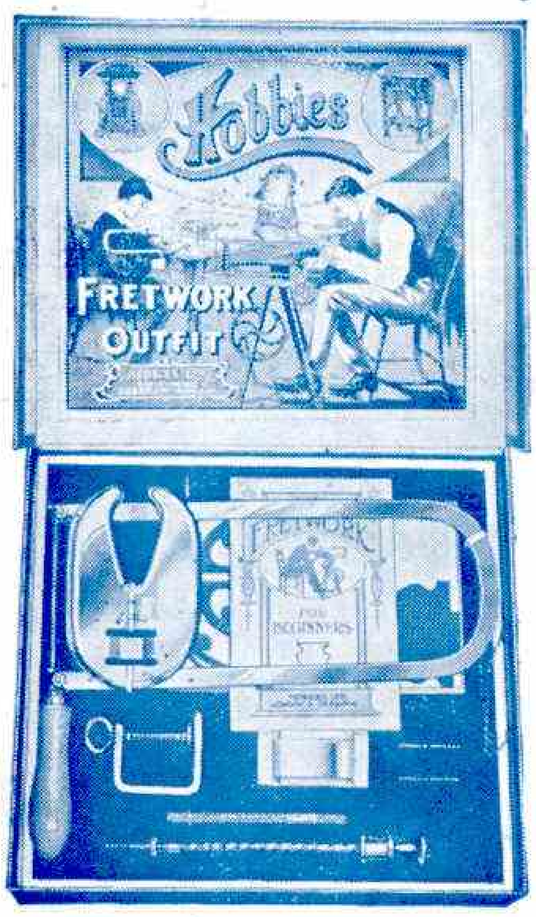

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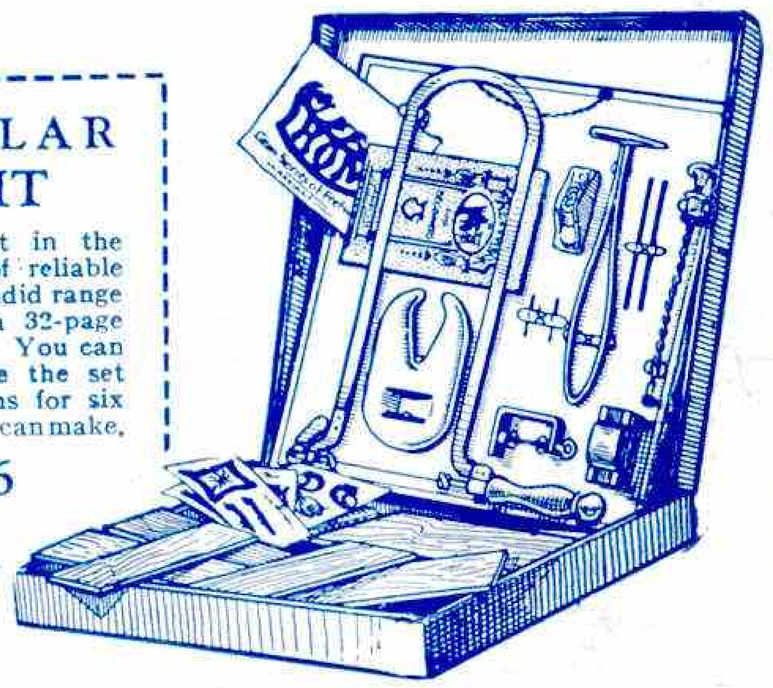

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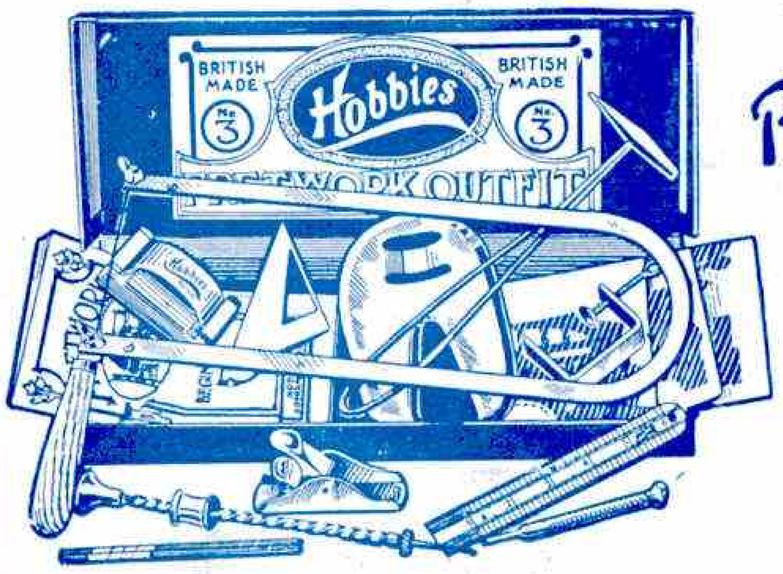

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With the Editor

1927: An Eventful Year

Looking back over the past year I am struck by the exceptionally large number of events of outstanding interest that occurred. Scarcely a month of 1927 passed without some epoch-making event taking place. The year was only a few days old, for instance, when the first regular telephone service between Great Britain and America was established and it became possible to exchange greetings or settle business across the Atlantic almost as easily as across one of our large cities. This great achievement was followed three months later by the introduction of the Marconi "Beam" system for wireless communication between different parts of the British Empire. The first Press message by the beam system was sent from Australia to Great Britain on 7th April, a date that will long be remembered as marking the commencement of a new era in Imperial communication.

One of the distinguished features of the year was the great advance made in locomotive engineering. Late in 1926 the Southern Railway brought into use the fine express locomotive "*Lord Nelson*" which, with a tractive effort of 33,488 lb., was at the time of its introduction the most powerful passenger locomotive in Great Britain. When the resulting excitement had died down a little, railway enthusiasts began to wonder what the Great Western Railway thought about it! Presently rumours began to spread regarding a new Great Western engine that was to make "*Lord Nelson*" take a back seat, and in due course there appeared the magnificent "*King George V*" with a tractive effort almost 10,000 lb. greater than that of the Southern Railway giant! The "*King George V*" is a superb example of British locomotive engineering, and one cannot help feeling proud of the manner in which this engine held its own among the huge giants that were assembled at the Centenary Celebrations of the Baltimore and Ohio Railway in America. Not to be outdone altogether, the remaining members of the "Big Four" have also introduced interesting new engines—the now famous "*Royal Scot*" on the L.M.S., and a "Pacific" with increased steam pressure on the L.N.E.R. More notable events on these railways, however, have been the inauguration of non-stop runs from London to Carlisle and London to Newcastle, respectively. The L.M.S. London-Carlisle run covers a distance of 299¼ miles and easily constitutes the world's record non-stop journey.

The opening of the Gladstone Dock at Liverpool, the largest dock in the world, was another outstanding event. The knowledge that we have such a monster dock in this country is very comforting in these days when America is apt to claim the biggest of everything! Speaking of docks reminds me that the year also saw the completion of the new battleships "*Rodney*" and "*Nelson*," representing the last word in grim fighting efficiency.

The secrets of seeing by wireless had been mastered to a large extent by Mr. J. L. Baird in previous years, but last year he proved the practicability of his invention by enabling people placed as far apart as Glasgow and London to see and converse with each other easily. I am quite convinced that it will not be many years before scenes will be broadcast as easily as sounds. The development of the use of infra-red rays for illuminating the objects to be transmitted was an achievement that promises great things. If this latest invention of Mr. Baird enables us to see through fog or in darkness, as has been suggested, sensational developments may be expected from it in the near future.

The most spectacular events of the year were brought about by the agency of the internal combustion engine. The first of these events was the amazing feat of Major Segrave, whose great Sunbeam racer far outstripped all previous records on land when it careered across the sands of Daytona Beach at a speed of over 200 m.p.h.—a record that still stands, in spite of several efforts to surpass it. In a feat of this kind one scarcely knows which to admire the more—the marvellous mechanical skill involved in the production of the engine or the wonderful nerve and self-control displayed by the driver.

Achievements in the Air

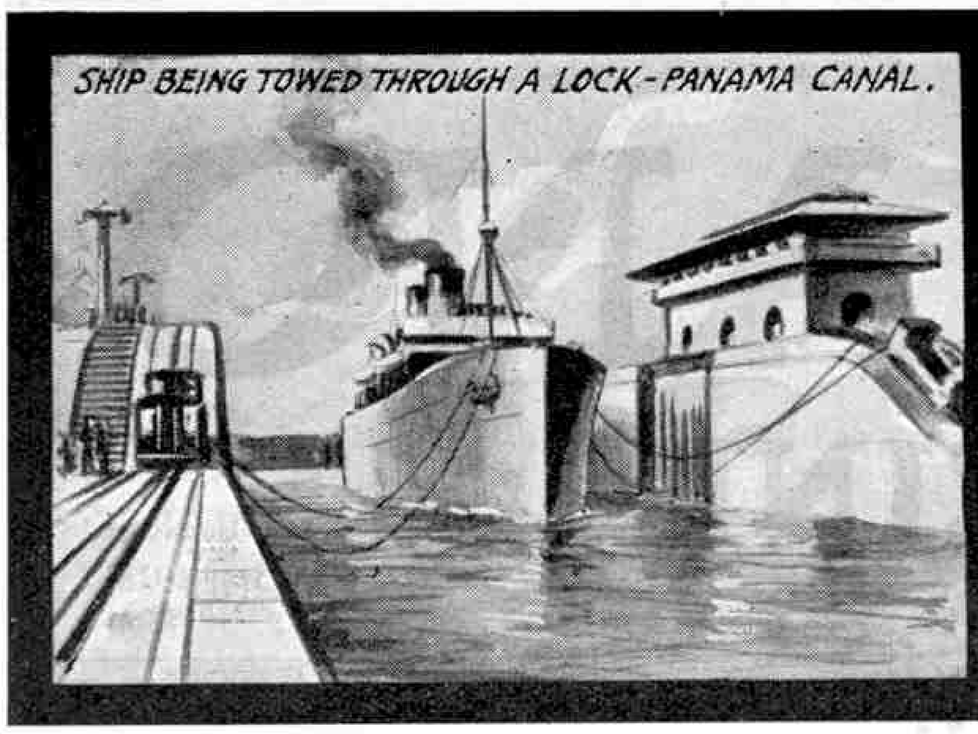
Remarkable developments in the air followed a little later in the year. Lindbergh, and subsequently Levine and Chamberlin crossed the Atlantic from New York to Europe, covering respectively distances of 3,639 and 3,923 miles in non-stop flights. These were undoubtedly achievements of the greatest importance and the airmen concerned are entitled to the greatest credit for their skill and courage, although we must not overlook the part played by the designer of the Wright "Whirlwind," the engine that carried them to success. (I cannot refrain from remarking, that it is now so long since the Atlantic was flown by two British airmen that the machine used by them has found its way into a museum!)

The most exciting event of the year in the aviation world was the race for the Schneider Trophy won for Great Britain by Flight-Lieut. Webster in a Supermarine-Napier seaplane, at a speed of 281.54 m.p.h. The full story of the great race is told elsewhere in this month's "*M.M.*" It is very interesting to note that the Italian airmen have since made a determined attempt upon the speed record in order to compensate themselves in some measure for the loss of the Schneider Trophy. Flying one of the Macchi-Fiat seaplanes that represented Italy in the race, Major Bernardi has secured for himself the honour of being the first man to travel at a recorded speed of over 300 m.p.h. Let us hope that one event of the present year will be the recovery of the world's air speed record by a British machine!

In one respect 1928 will be inferior to 1927 and that is in regard to the importance of the centenaries celebrated. Last year saw the 200th anniversary of the death of Sir Isaac Newton and the 100th anniversary of Alessandro Volta. Newton was easily the greatest man of science that England—and perhaps, indeed, the world—has ever produced, while Volta was virtually the founder of the gigantic electrical industry that now plays so great a part in modern life.

The anniversaries that will occur in 1928 are mostly of much less importance. Two of them deserve mention, however, the first being the 200th anniversary of the birth of the famous voyager Captain Cook, who was born on 27th October, 1728. Cook's adventurous career is more or less familiar to all my readers and he may be said to have explored a greater extent of new coastline than any other navigator in the history of the world. The other anniversary concerns Joseph Black, Professor of Chemistry in the University of Glasgow, who also was born in 1728. The discoveries of this great chemist in connection with gases entitle him to be regarded as one of the founders of the science of chemistry. He was also the discoverer of the principle of latent heat. It is interesting to note in this connection that Black was a life-long friend of James Watt, and there is little doubt that the conversations between the friends had much influence on Watt, as in them his attention was drawn to the properties of steam. On this account alone Black is worthy of remembrance.

As in the past, it will be my endeavour in 1928 to keep readers of the "*M.M.*" fully informed on all events of importance. Not only does this apply to engineering and mechanical subjects, but also to all phases of activity and development that help forward the march of world progress.



FAMOUS CANALS OF THE WORLD

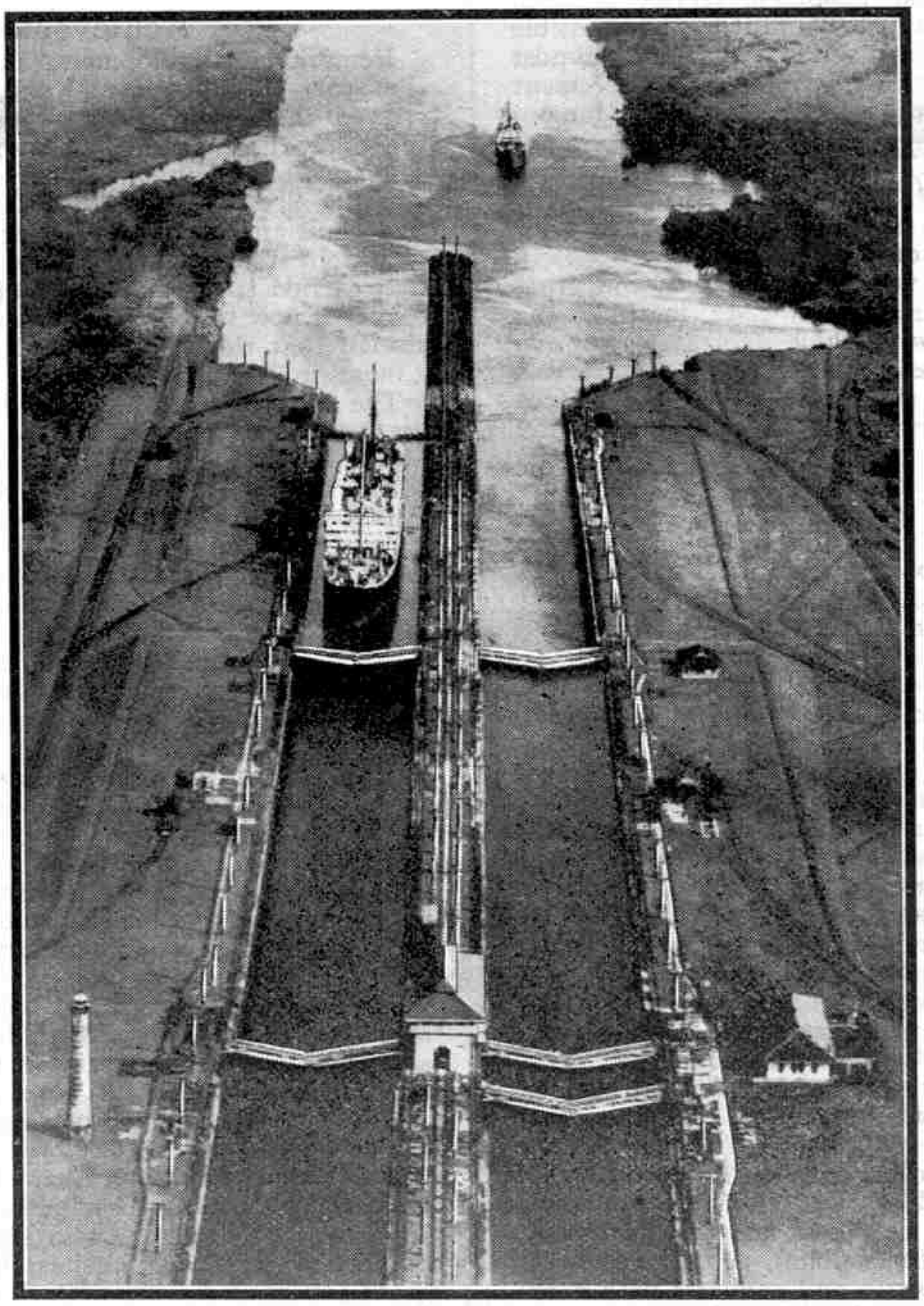
VII.—THE PANAMA CANAL

LAST month we described the unsuccessful efforts of the French to construct the Panama Canal, and the dramatic circumstances in which the Panama Government granted to America the necessary right of way across the Isthmus, after the French contractors had been bought out.

The first Isthmian Canal Commission, which had been engaged since its formation in 1899 in conducting investigations as to the best route for an American canal, now took over the task of organising the work at Panama. Various appointments were made, one being that of Colonel W. C. Gorgas of the U.S. Army to be head of the Sanitation Department at the Isthmus. President Roosevelt urged the Commission to adopt a policy of "hustle" and to "make the dirt fly." Thus every effort was made from the start of the American campaign to expedite the construction of the canal.

At the time when America took over from the French the actual control of the canal works, about 600 to 700 labourers were employed on the site, the majority in the Culebra Hill section. As the months passed this number was steadily increased by the influx of hundreds of skilled American workmen and of a considerable number of West Indian natives from Barbados. By the close of 1905 there were 5,000 men engaged on the canal works, and this number afterwards increased rapidly.

Strenuous efforts were made month by month to create new records in the amount of materials excavated, and Colonel Gorgas pointed out to the Commission that they were committing the same error as the French companies by rushing forward the work of constructing the canal before definite steps had been taken to establish health conditions within the canal zone. They ignored him, however, being misled by the fact that at the time they took over the canal undertaking there was a lull in the fever epidemics.



A wonderful air view of the Cunard liner "Laconia" passing through the Gatun Locks on her cruise round the world

Within a year the warnings of Colonel Gorgas proved only too well founded. In December, 1904, six cases of yellow fever occurred, one proving fatal, and the following month 19 cases were reported, of which eight ended fatally. During the ensuing months the fever claimed an increasing number of victims. When it was disclosed to the American Senate in April, 1905, that a serious outbreak of fever had occurred at the Isthmus and that practically nothing was being done by the Canal Commission to prevent the spread of disease, the latter were dismissed from office. A new Commission was then appointed and, in the hope that by being on the spot the members would be better able to govern, they were ordered to meet quarterly at Panama, instead of at Washington as the first Commission had done.

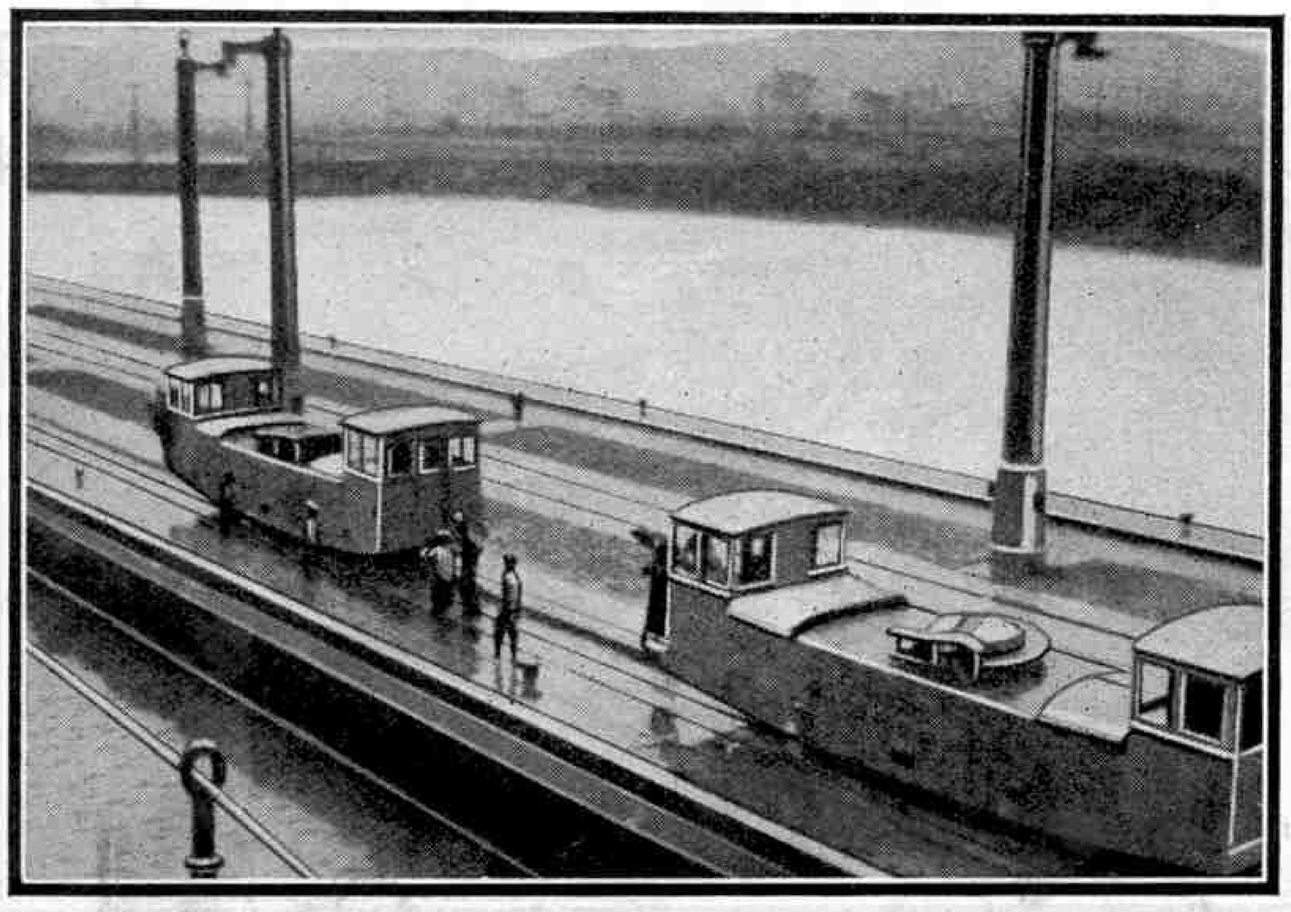
Wallace, the Chief Engineer, had chafed greatly at the old Commission's lack of consistent policy and, having no belief that the new overseers would govern any more effectively, he resigned. His place was taken by John F. Stevens, who accepted the appointment only on the understanding that, while the Commission might advise him of their desires, he was to have a free hand in all matters. He would not consent to remain in office longer than was necessary for him to ascertain decisively whether the canal scheme, as being carried out, would prove a success or a failure. To these demands President Roosevelt acceded. In May of the same year Charles E. Magoon was appointed Governor of the canal zone.

The fever epidemic at the Isthmus continued to rage, 62 cases being reported in June. Something of a panic developed among the white people employed, and many Americans gave up their jobs, gathered their belongings together and hastened home by the first available steamer. The U.S. Senate, fearing a public outcry against the state of affairs at the Isthmus, urged the new Commission to take immediate and active steps to stamp out the causes of the epidemic. Magoon, Stevens and Gorgas thereupon conferred together, with the result that the construction of the canal was temporarily relegated to second place, and thousands of labourers were withdrawn from the work in order that their energies might be devoted to transforming the canal zone from a pestilential area to a place safe and fit for the white man to inhabit.

During the years since de Lesseps had first commenced the construction of the Panama Canal, medical science had advanced considerably in its knowledge of how to combat tropical diseases,

thanks to the pioneer work of Ross, Lazear and other British medical men. This knowledge was now utilised at the Panama Isthmus.

Although America had not taken possession of Colon and Panama, it had accepted responsibility for their sanitary conditions, and the two towns were now subject to a cleansing such as they had never before experienced. All refuse and dirt was collected and burnt; ambulance squads were organised to remove all sick cases to hospitals and homes that were equipped with protective screens to keep out mosquitoes. Every house was fumigated with sulphur, waterworks were constructed on the outskirts of the towns and comprehensive drainage systems were laid down. So effectually and speedily was this work accomplished that on 4th July, 1905, water for public use was turned on in Panama for the first time, from a main in the Cathedral Plaza.

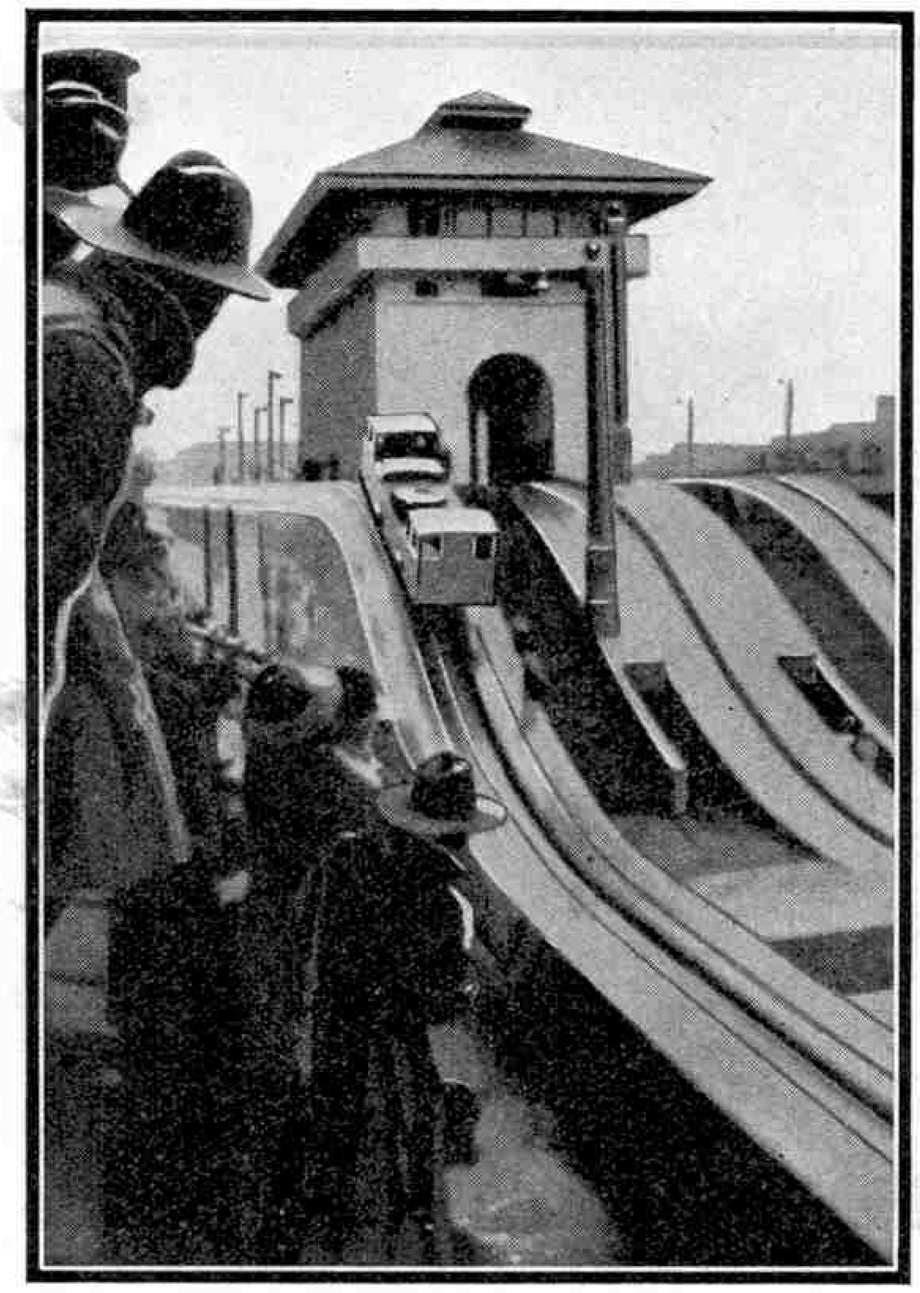


Two of the electric mules for hauling ships through the locks. The mules have a capstan in their centre, to which is attached the hauling rope

In order to banish completely the particular type of mosquito that carried malaria, all forest and undergrowth was cleared away throughout a radius of several hundred yards around each settlement and village on the canal route. Wherever possible stagnant ponds and pools were drained and cleaned up. In cases where this was not possible certain fish were introduced that had a special liking for the larvæ of the mosquito. The most effective measure, however, consisted in spreading kerosene upon the water in pools and ditches, by means of oil drippers. The oil formed a film on the surface of the water and destroyed the mosquito larvæ by preventing them from reaching the surface to breathe.

Repairs were carried out to over 1,500 buildings of various kinds, taken over from the French, and more than 2,000 new structures were erected in towns and settlements within the canal zone. The new edifices included churches, schools, shops, offices, canteens and, in some localities, improved quarters for the workmen. For this work 75,000,000 cu. ft. of timber, imported mostly from Puget Sound, was used within 18 months. Gambling was forbidden and, except at Colon and Panama, alcoholic drink was absolutely prohibited. Large supplies of food were imported from America to obviate dependence upon the supplies served up by the natives in a manner unsatisfactory to white people.

As a result of this colossal renovation the casualties from fever diminished to about one-third of the previous average. During the work the Sanitation Department made heavy calls upon the labour employed on the canal works, but operations on the canal were never wholly stopped. As soon as the canal zone had been cleaned up the labourers were returned immediately to their original tasks and the speedy construction of the canal became once more the primary object.



The electric mule descending one of the ramps on the Pedro Miguel Lock. The building in the rear is the control house

While work upon the canal was proceeding on a temporarily reduced scale a heated controversy raged in America as to whether the canal should be a sea-level waterway throughout, or should be of the high level type, equipped with series of locks. A special committee comprising many eminent consulting engineers, five of whom were appointed by European Governments, was formed in 1905 to consider both schemes in detail and pronounce an authoritative verdict. The committee began by visiting the Isthmus and thoroughly investigating the canal route, and later conferred together. The conferences found opinion divided, and two reports were ultimately drawn up and submitted, in January 1906, to the Canal Commission. The first report showed that the majority of the committee favoured a sea-level canal which, they stated, could be constructed in about 12 years at a cost of less than $250,000,000. The second report detailed the opinion of the minority, who contended that a high-level canal would greatly reduce the amount of necessary excavation; that it could be constructed in considerably less time than a sea-level canal and at a saving in cost of approximately $100,000,000. They also declared that a high-level canal would be easier to navigate and would be more economical to enlarge, if necessary, at some future date. A third report submitted was prepared by Stevens, the Chief Engineer, who also favoured a high-level canal.

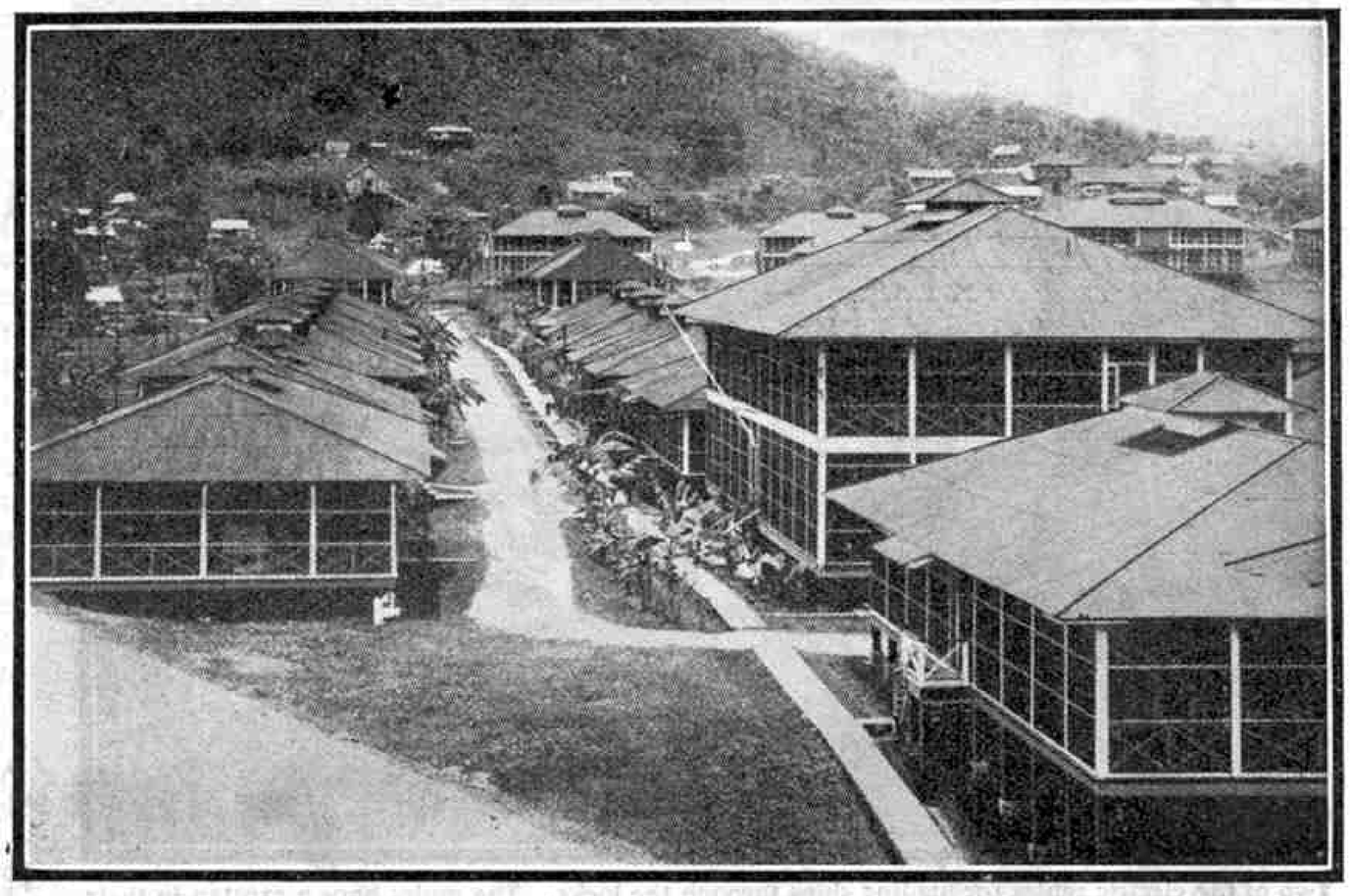
A meeting of the Canal Commission was called and the three reports were carefully studied, with the result that the majority decision of the consulting engineers was revoked and the Commission voted in favour of a high-level canal. One of the reasons for their decision was that such a canal would be more immune from the seasonal flood-waters of the River Chagres and other streams than would a sea-level canal. The Commission then conveyed their recommendation to the President who, in February 1906, submitted the whole question to Congress for a final decision. In June of the same year Congress confirmed that the canal should be of the high-level type, and thus the momentous question was finally settled.

When it was known at the Isthmus that the canal was to be of the high-level type, work was at once commenced upon the clearing of sites for the erection of dams and locks. It was decided that at the Atlantic end the canal should be maintained at sea level as far as Gatun, seven miles inland. There a huge dam was to be erected across the valley of the River Chagres, creating a lake 22 miles in length and extending to the Culebra Cut. Access to this summit level of the canal was to be provided by a three-tier double flight of locks, at Gatun. At the Pacific end of the Culebra Cut a lock in duplicate was to be made at Pedro Miguel, followed almost immediately by two lower "steps," each consisting of two locks abreast, and which would bring the canal down again to sea level. An eight mile level length of waterway would lead to the termination of the canal at Panama.

The construction of the dam at Gatun, where the valley is 1½ miles in width, was a remarkable engineering triumph, for this great structure rests upon a river bed foundation consisting solely of gravel bound firmly together with clay and mud. In places this deposit continued to a depth of nearly 300 ft. before coming to solid rock. The soft nature of the alluvial deposit of the river bed created considerable misgivings as to its ability to take the weight of the dam, and it provided the advocates of a sea-level canal with one of their most

potent arguments. A dam constructed entirely of concrete was regarded by the canal engineers as wholly impracticable, and an earthen embankment of great breadth was therefore built up, with sides of gradual slope in order to distribute the weight of the mass over as much of the soft river bed as possible.

A strong buttress of rocky material was erected at each end of the dam and the centre portion filled in with sand, into which water was pumped by 20 in. centrifugal pumps. The saturated sand was then compressed by hydraulic means until it was rendered absolutely water-tight. The surplus water was then led away through pipes. Some idea of the immensity of this operation may be obtained from the fact that 21,145,931 cu. yds. of earth were used in constructing the dam. A protective stone facing was provided where the dam was to be in contact with water. From a width of 2,100 ft. at the base, this massive barrier tapers, with an inward curving face on the lake side, to a uniform width of 100 ft. at the top. The dam is 7,200 ft. in length, including the "spillway," and towers to a height of 105 ft.



Living quarters at Pedro Miguel. Note how the houses are protected by wire netting against mosquitoes

The spillway just referred to was built in the central portion of the dam to provide a means of discharging surplus water from the lake. It is semi-circular in shape, being concave on the side facing upstream, and it projects above the dam. 225,485 cu. yds. of concrete were used in its construction. The spillway contains 14 openings, each of which possesses a grooved frame wherein is a massive 42-ton steel gate, 20 ft. in height and 45 ft. in width. These gates are mounted on roller bearings and are electrically operated. When all the sluices are open, 170,000 cu. ft. of surplus water can be discharged per second, the water passing through the open gateways at the rate of 35 ft. per second. It is led thence to the sea by way of the old bed of the Chagres River. Two rows of reinforced concrete piles each 10 ft. in height were erected across the lower part of the spillway to act as a check upon the water descending from the sluice gates. Each pile was strengthened and protected on its upstream side by massive cast iron blocks.

While the task of erecting the dam was in progress the valley was cleared of trees and obstructions along a course 500 ft. in width, to be defined, when the lake was filled up, by floating buoys. This course is the deep channel along which ships negotiating the Gatun Lake now pass. The Panama Railroad was deflected from its original course along the Chagres Valley to a route more or less bordering the new lake. In parts the railway traverses the lake, being carried on a high embankment built up with material excavated at Culebra Cut. Numerous reinforced culverts were made in the railway embankment to allow the water to pass freely beneath and equalise, as much as possible, the pressure upon the bank.

Spraying with oil the ditches where the mosquitoes breed

At Culebra Hill the two French companies had excavated nearly 19,000,000 cu. yds. of earth, but this represented only about a quarter of the excavation necessary to complete this section of the canal. Most of the material removed had been soft earth, and it was left for the American engineers to carry out the deeper cutting through the underlying stratum of rock. For this purpose the engineers imported to the Isthmus considerable extra mechanical plant in order to speed up the work as much as possible, and by the beginning of 1907 excavation was being carried out at Culebra at the rate of 750,000 cu. yds. per month.

The large number of mechanical excavators daily employed in taking great bites out of Culebra Hill included 77 Bucyrus 95-ton steam shovels, each capable of removing and loading earth at the rate of 600 yards per hour. The shovels were scoop-shaped grabs having a hinged bottom and a toothed upper edge. In operation, a scoop, with the flap closed, was pushed against the earthen bank and scraped upward until it was full, when it was hoisted upward and swung directly over one of the waiting empty trucks. The flap was then manipulated and the scoop emptied into the truck below, after which the flap was mechanically closed and the apparatus swung back to the bank for another load.

In clearing a way through the rocky stratum patent boring machines were used to prepare the rock for receiving the blast charges. After the subsequent explosion the debris was gathered up by the mechanical shovels. The plan adopted in excavating the Culebra Cut was that of cutting along the sides in terraces, a railway track being laid along each level to accommodate excavating machinery and trucks. Wherever possible the removed earth was utilised on some other section of the canal works, and material not thus accommodated was used to fill up large depressed areas. Despite every endeavour to save time and transport, the loaded "soil trains," as they were called, had sometimes to travel four or five miles before reaching their nearest dumping ground.

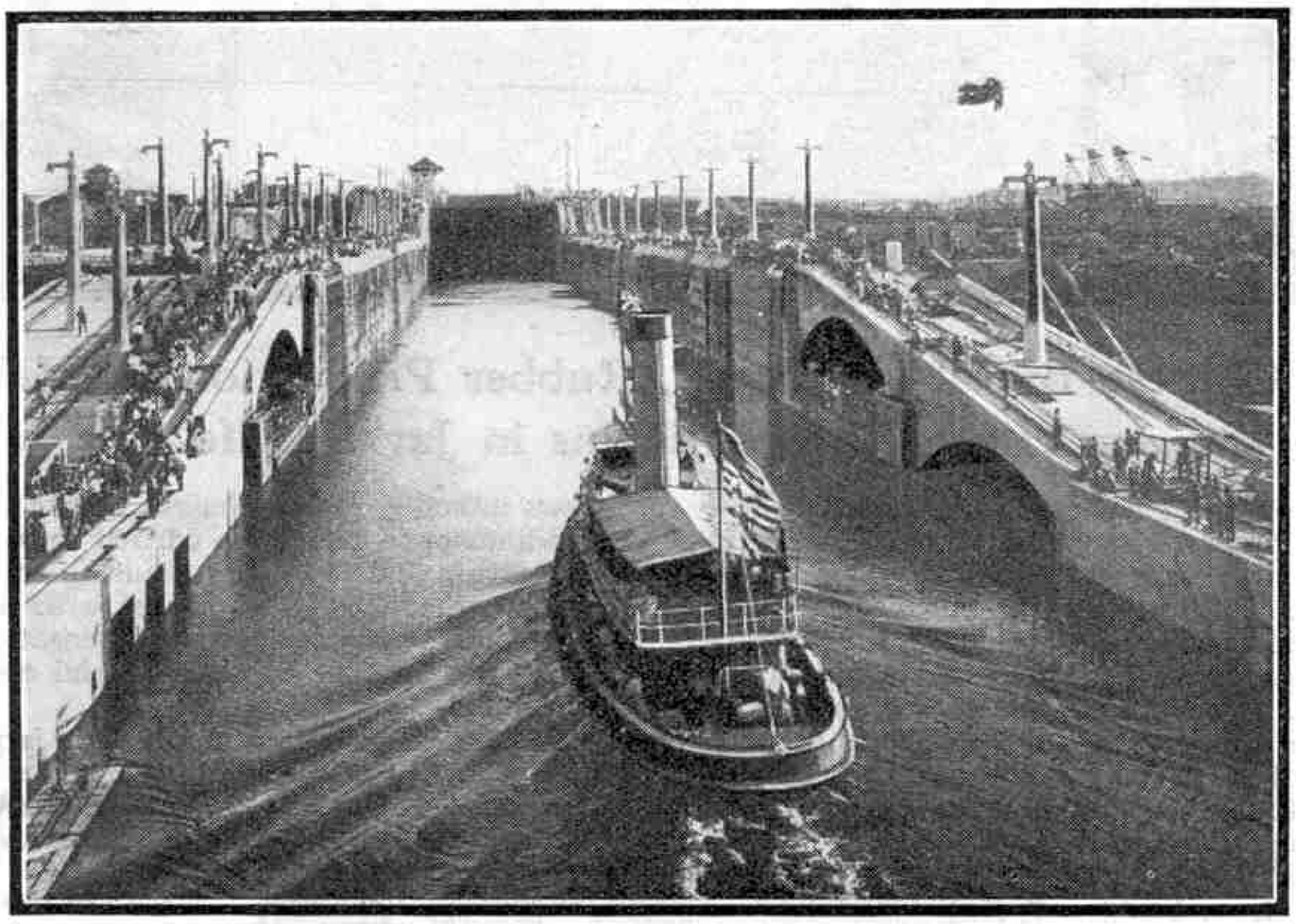
The amount of work necessary in the Culebra Cut was increased tremendously by the periodical landslides that occurred. The collapsing earth dropped into the channel bed, carrying with it from the various terraces, excavating machinery, empty and loaded wagons, and sometimes locomotives, while long sections of track were torn up and submerged. Of 14,927,750 cu. yds. of earth excavated in 1910 as much as 18 per cent. was due to landslides. To reduce this menace as much as possible the sides of the canal at Culebra were made to slope less acutely than was originally intended.

The channel excavated through the Culebra Hill was roughly nine miles in length, with an average depth of 41 ft. to conform with the rest of the canal and with a bottom width of 300 ft. As already stated, the banks were moderately sloped, except where these were of rock, in which case they were cut practically vertical. The summit level opened out at Obispo into the Gatun Lake, and at the other end communicated with the topmost locks (Pedro Miguel) on the Panama side of the hill.

The various locks connecting the sea-level sections of the canal with the summit level were constructed of concrete, the materials for which, with the exception of cement, were obtained on the site. At Gatun the locks were erected after the fashion of two 3-step

staircases side by side. They were built into the hillside, and considerable excavation therefore had to be carried out before the massive concrete structures could be commenced. More than 2,000,000 cu. yds. of the material excavated was utilised in making the subsequent concrete for the locks. Each lock has a usable length of 1,000 ft., is 110 ft. in width, 41.3 ft. in depth at the "sill," and has a lifting range of 28.3 ft. In addition to the double swinging entrance gates at both ends of each lock, intermediate gates are provided to enable small vessels to be passed through the lock without filling up the entire basin with water.

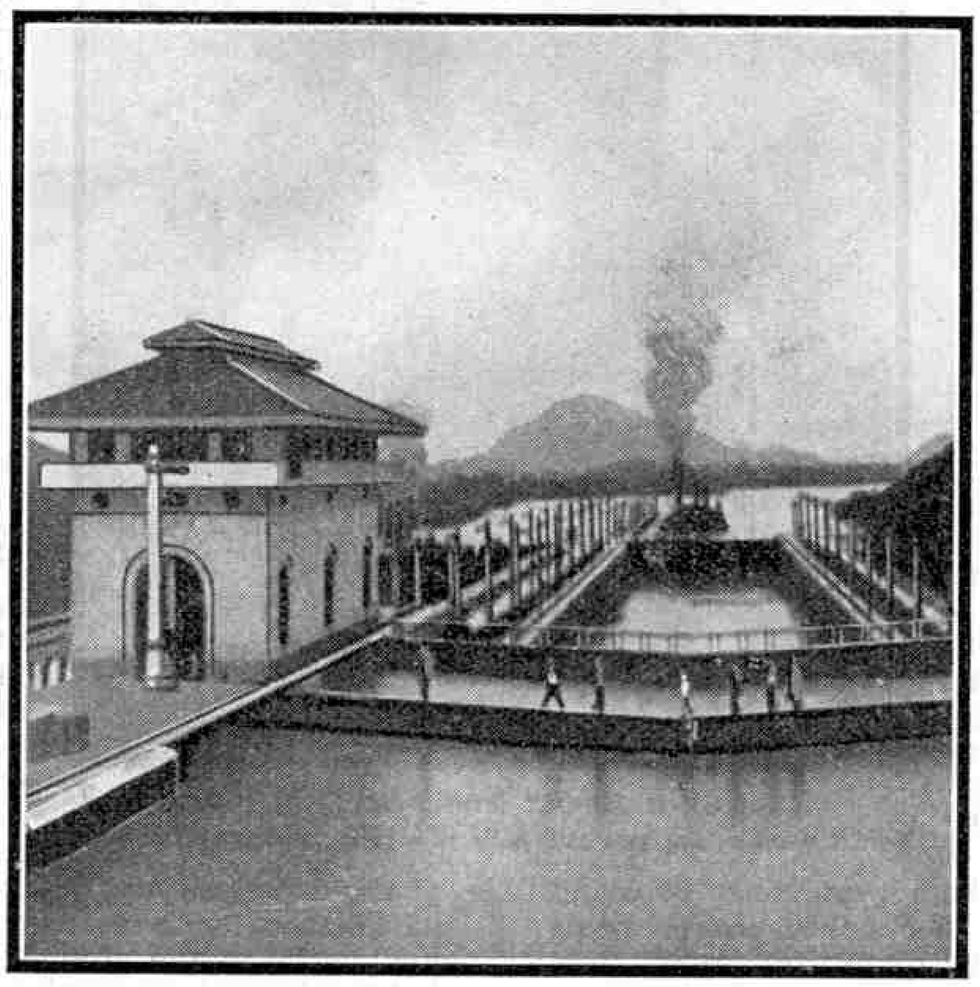
The locks nearest the summit level are provided with an emergency pair of gates as a precaution against any vessel inadvertently ramming one pair. As a further precaution against such a mishap, heavy steel "fender" chains are laid across the floor of each lock, each chain being placed about 75 ft. from the gates. When a vessel slowly enters any of the locks the chain is raised by hydraulic machinery. Upon the vessel coming gently into contact with the chain, the latter is paid out, but slowly enough to act as a brake upon the ship, and a 10,000 ton vessel entering a lock at a speed of five miles per hour can be brought to rest by this means within a distance of 70 ft.



Passing through the Gatun Locks. This view clearly shows the ramps and beyond, the height to which the ship has to be raised

The machinery provided for aiding vessels in their passage up and down these remarkable concrete stairways is of marked interest. As will be seen from the illustration on this page rail track is laid along the whole length of the massive lock walls, and forms the runway for electric locomotives, or "towing engines" as they are termed, of which there are 40 at Gatun. Four of these sturdy engines are required to guide a vessel through the locks. A toothed wheel beneath each locomotive engages with a toothed rack laid between the track. By the aid of this, in conjunction with their own motive power, the engines pull themselves up the inclined rail track from the lower locks to the higher.

A vessel desiring to ascend the locks is stopped outside the bottom lock. The towing engines relegated to take charge of it hurry down; hawsers are thrown across to the ship and the engines thus connected up, two ahead of the vessel to tow it and two in the rear to check the vessel's speed and prevent it from swinging around in the lock. The gates of the lowest lock are then opened, the vessel towed in and the gates closed. As the lock is being filled and the ship is lifted at the rate of 2 ft. per minute, the tow ropes are paid out and the locomotives ascend the tracks to the next lock above. When the lower lock is full, the gates are manipulated and the ship towed into the higher lock, where the cycle of operations is repeated. At the topmost lock the tow ropes are cast off, and as the vessel enters the Gatun Lake, the engines move away to their next charge.



The Miraflores Lock. Note how the upper lock has a double pair of gates which are to prevent the heavy pressure of water from forcing them open

The double flight of locks makes it possible for one vessel to be ascending to the lake while, by means of the adjoining stairway, another vessel may be descending to the sea level canal.

After ascending the Gatun locks, crossing the vast lake and passing through the Culebra Cut, a vessel comes to the Pedro Miguel locks, a single flight of two locks abreast. These locks are patterned after those at Gatun and effect a difference of 30⅓ ft. in the level of the canal.

Below the Pedro Miguel locks the canal passes through a small lake about 1,200 acres in extent, and roughly 2,000 yds. in length. Two dams, an earthen one on the west and a concrete one, containing a spillway, on the east, ensure the elevation of the canal between the two sets of locks being maintained at 55 ft. The west dam is 2,300 ft. in length with a width at the top of 40 ft., while the east dam is 500 ft in length. The spillway embodied in the latter is of the same dimensions as that at Gatun, and contains seven openings, permitting a total discharge of 7,500 cu. ft. of water per second.

From the small lake to Miraflores, almost a mile distant, the canal was made 500 ft. in width. At Miraflores two flights of twin locks were constructed, each effecting a difference of 27½ ft. in the level of the canal, and leading directly into the eight-mile length of sea-level waterway that terminates at the Pacific Ocean. The two Pedro Miguel and the four Miraflores locks were all constructed to the same dimensions as the locks at Gatun.

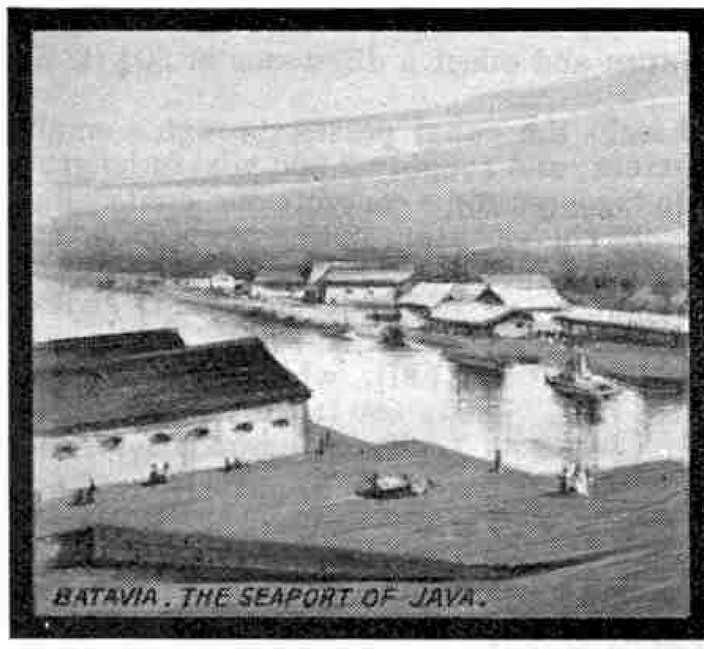
At Colon and at Balboa, near Panama, breakwaters were erected to protect the canal entrances, in the former case from the violent storms that lash the coast during the winter months, and in the latter from silt-bearing currents, the deposits from which would otherwise choke up the Pacific entrance.

In 1907 Stevens resigned from the post of Chief Engineer to the Canal Commission, and Col. Goethals, another American engineer, was appointed in his place. Like his predecessors, he did not see eye to eye with the Commissioners in regard to construction policy, and another crisis was only averted by the intervention of President Roosevelt. Ultimately Goethals was given absolute command of operations at the Isthmus. Under his able directorship the construction of the canal was carried out systematically and speedily, and at length the great work was completed.

On 10th October, 1913, President Wilson, by pressing a button in Washington, caused the last barrier in the canal channel to be blown up. Shortly afterwards the canal was officially opened to traffic.

The completed canal, from deep water in the Atlantic Ocean to deep water in the Pacific Ocean, is 50½ miles in length, and a voyage throughout occupies from nine to twelve hours. The canal has made possible to vessels voyaging from one coast of the United States to the other a saving of roughly 8,000 miles, while the trans-Atlantic voyage from Liverpool to ports on the Pacific coast north of the Panama Canal is shortened by more than 6,000 miles.

It is interesting to note that the United States Secretary for War recently advocated the construction of an additional dam on the Panama Canal in order to increase the available water supply. The proposed dam would be built across the Chagres River at Alhajuela, 14 miles above the point where that river enters the canal, and would be of such dimensions as to impound the waters of the river to the extent of forming a lake 20 sq. miles in area and having a capacity of 22,000,000,000 cu. ft. It is estimated the dam could be built in six years at a cost of £2,400,000.



MY TOUR ROUND THE WORLD

by

FRANK HORNBY

VI. Chinese Burial Customs. Rubber Production in Malaya. Borobudur—the amazing Hindu Temple Ruins in Java. Life in a Javanese Village.

THE curious floating city on the Pearl River at Canton that I described last month prepared me for strange sights in Canton itself, and I was not disappointed. On going ashore I visited the native quarters, having engaged a sedan chair for this purpose. It is fortunate that I did so, for the sanitary conditions there are appalling, and worse than anything I have ever experienced elsewhere. The thoroughfares are so narrow that in some of them there is not room for two chairs abreast. Open sewers run down some of the passages and the city is traversed by several open ditches. Refuse is thrown into any available corner and in the ditches in particular are collections of appalling rubbish, including dead animals, no regard whatever being paid to the health of the hordes of people who live and work in these narrow thoroughfares. The visitor to Canton must be prepared to have his senses of sight and smell outraged!

The shops are brilliant with gilding and red paint, and it is just as well, for the daylight can scarcely penetrate into the narrow lanes containing them. There are crowds of people everywhere, for Canton has more than two million inhabitants and they are crammed into a space smaller by far than that which accommodates any other two million people on the face of the globe. On second thoughts the visitor realises that the people who live in the sampans on the river are much better off than the majority of those who live in the city.

Chinese labour is notoriously the cheapest in the world and the conditions under which the lower-class people work are at their worst in Canton. The coolies are the beasts of burden, the scavengers, the farm labourers, the navvies and the jacks-of-all-trades, from one end of China to the other. They work for a bare existence and at night time go to rest in the most squalid and dismal of habitations, or even in the open street. Even in Hongkong it is no uncommon sight to see a number of natives sleeping on the sidewalks with a canvas sheet or anything else they can obtain over them, and in the dark places one is apt to walk over them!

Tapping a rubber tree by a "V" cut
Note the collecting can and pails in which to remove the latex

With such a number of people for whom work must be found there is little prospect of up-to-date mechanical means being provided for turning out goods in large quantities, apart from the prejudice that the Chinese have against new methods.

One of the consequences of the low wages of the coolie is the astonishing variety of cheap and nasty foods that may be bought in such places as Canton. The smallest Chinese coin is the "cash," of which one thousand make one tael, or about 6s. 8d. in English money. It is made from base metal by casting, and not by coining in the usual manner with dies. A few cash go a very long way in Canton markets and very small purchases may be made. It is possible to buy monkey nuts three at a time, or a quarter of an orange, or half a cooked fowl's leg! Among the articles I noticed hanging up in the market were strings of chickens' claws intended for purchasers with very limited means.

Whatever is bought is carried away dangling on the end of a thin string and it is very amusing to see some of the purchases. A man returning from market with a single raw kidney at the end of a thread would create a sensation in our own country, but it is quite possible to see this and even more astonishing sights in China!

Chinese dainties are not to be inquired into too closely by Europeans. Foodstuffs in the shops seem to be exhibited in a manner that makes them as unpleasant as possible to western eyes. Cooked ducks that have been flattened out in the process of preparing them for the table until they seem to have been crushed to death; fowls so cooked that they have acquired an unpleasantly white and shiny appearance; cooked dogs that seem to have been blown out to make them look fatter; and fragments of meat that look as if they have been torn off by a tiger's paw—all these may be seen in almost any Chinese city! In Canton there are actually shops where rats, either dried or fresh, may be bought prepared for cooking or ready boiled. The Chinaman also likes greenish-brown worms gathered from the rice fields, and prefers his eggs to be discoloured and very highly flavoured!

The Chinese are very religious in their own way. The basis of their religion is ancestor worship. In their beliefs they exhibit a good deal of superstition, and this is particularly shown when one of their number dies. His relatives must supply his spirit with necessities and comforts for his stay in the other world, and they send him money, clothing, and even houses in the form of burnt offerings! This is not done literally, of course. Paper models are used, money being represented by joss sticks with a dab of silver paint on them. It is supposed that the substance of these offerings floats away to the recipient in the smoke produced on burning them.

The place of burial is of equal importance to the welfare of the spirits of the departed, and also of their descendants. Canton is typical of Chinese towns in regard to this custom. The poor quickly find burial in the ground outside the deserted walls of the city, but the funeral ceremonies of the richer classes are far more elaborate. The body, in a huge coffin that looks like a lacquered tree trunk, is first taken to an enclosure called the "*City of the Dead*," where it rests in one of the numerous two-roomed buildings until a suitable burial place is found. In the other room are chairs and an altar decorated in the brightest of colours. Here relatives and friends visit the dead man and offer sacrifices on his behalf, and a fresh cup of tea for the departed spirit is placed in the room every day!

Finally, after much consideration of the effects of the site of the tomb on the happiness and prosperity of all concerned, the

actual burial ceremony takes place. Months and even years may be spent in searching for a suitable place. These tombs are to be seen scattered in all directions up and down the river, but I understand some restrictions have now come into force limiting the area in which they may be built.

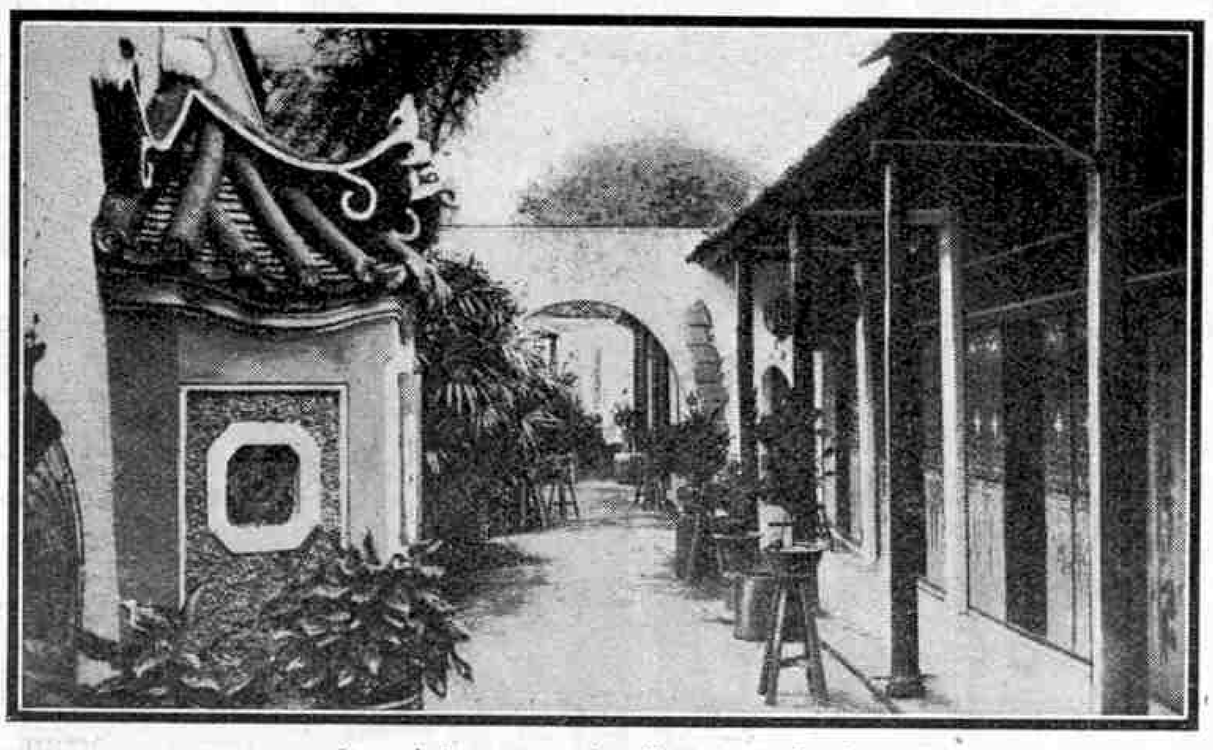
Soon after my return from Canton I left Hongkong for Singapore, a sea voyage of 1,440 miles. We were getting nearer the equator during the whole of this journey and I expected to have the fact brought home to me by an unpleasant rise in temperature. This was not the case, however, and in fact I found the climate of Singapore itself exceedingly pleasant and very much like our best summers. The explanation of the mild climate is, of course, the position of Singapore on the sea-shore. Its temperature in consequence does not vary very greatly the whole year round in spite of its proximity to the equator, and the nights especially are cool and refreshing.

Decorated shrine in one of the resthouses of the dead

Singapore is the largest of a group of islands at the extremity of the Malay Peninsula. It is 27 miles in length and is separated from the mainland by a channel less than half-a-mile in width at its narrowest part. The surface is undulating and presented an exceedingly green appearance as we approached it. This, I afterwards learned, is due to the dampness of the climate, the abundance of moisture in conjunction with the genial warmth causing vegetation to flourish luxuriously. Palms, ferns and gorgeous orchids are to be seen everywhere. So quickly does vegetation grow that clearings in the forest are very quickly choked up by it. A few heavy showers and a day or two of sunshine produce a thick growth of weeds that reaches a height of six feet in two or three months!

The town of Singapore itself I found to be extremely well-appointed. Its administration by the British is very enlightened, and one interesting example of the benefits of our rule is that malaria is no longer a menace. The work of Sir Ronald Ross in exterminating the malaria-carrying mosquito has resulted in almost complete mastery over this dreaded disease. In this respect a comparison of Singapore with Canton is interesting. It would certainly be difficult to clean up the latter city on account of its size and antiquity, but very little attempt seems to be made to ameliorate its frightfully insanitary conditions. The great majority of the inhabitants of Singapore are also Chinese, but they have readily adapted themselves to the rules that keep the town in a healthy condition.

The Chinese are predominant in numbers almost throughout the Malay Peninsula and in fact it has been said that they are turning the Peninsula into a second China. The other people to be met with here are a most cosmopolitan collection, including Malays, Hindus and Javanese, in addition to a comparatively small number of Europeans.



A quiet corner in the sacred city

Singapore and the Malay States are chiefly known nowadays as the great source of rubber. A drive through the plantations near Singapore proved very interesting indeed, as I was able to see the operation of extracting the raw rubber from the trees. The cutting of an incision in the bark of the rubber tree is familiar to most people, but I was interested to learn that the system of making herring-bone cuts is now being abandoned in favour of a single "V" at the base of the tree. In addition, the desire to conserve the trees has led to a tendency to tap them on alternate days only instead of daily as was previously done.

The milky latex oozes out from the cut and runs into small cups fixed at the lowest point where it is collected in pails by coolies and taken to the coagulating station. Here it is strained to free it from bits of bark and other impurities, and then stirred in iron pans with a little acetic acid. This causes coagulation or the formation of the solid rubber from the milky liquid. The rubber is then dried, usually by hanging in the upper part of a room in which are smouldering fires that produce plenty of smoke but no flame. The smoke not only dries the rubber but improves its quality. The smoking process is practically the same as that used by the natives in Brazil, the original home of the species of rubber trees now grown in Malaya. I was informed that practically all the rubber trees in the east originated in a few seeds collected in Brazil by an Englishman and germinated at Kew Gardens.

I saw something of the wild side of the district when I motored a little way out from Singapore. On one occasion I passed through a jungle where innumerable monkeys abound, and I succeeded in coaxing some of them out with the aid of a few bananas. They were very nervous, but could not resist the temptation of the fruit that I threw to them. As each one of them secured a banana it rushed back into the jungle and could be seen eating it while sitting among the branches of the trees.

After spending several days in Singapore I left for Java. While the steamer was lying alongside the wharf preparatory to sailing, the passengers were entertained by a number of Malay boys diving after coins thrown into the water, these being invariably secured by one or another before they sank to the bottom. It is most extraordinary how venturesome these boys are, some of them are not more than children, in risking their lives for such a small recompense in water where sharks are nearly always present. I noticed one of the boys smoking a cigar. He held this in his mouth when diving, and when he emerged again he resumed his smoke. I was curious to know how this was done, and subsequently I learned that before entering the water he placed the lighted end in his mouth.

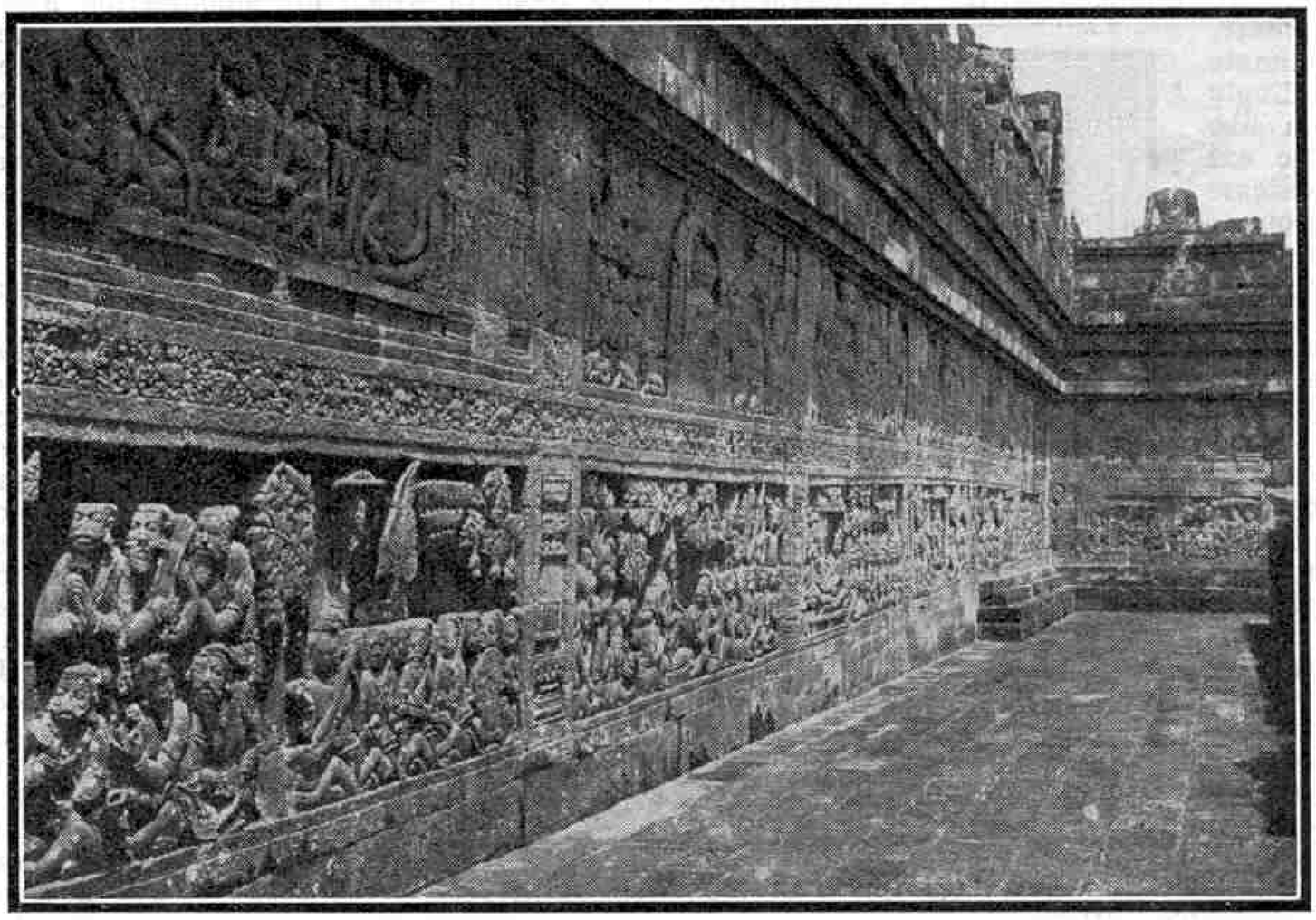
I was led to visit Java by a curiosity to see something of the great islands of the East Indian Archipelago. The position of these islands, stretching over the ocean between Asia Minor and Australia, has always made them interesting to me, while I knew that they were specially favoured in climate and that some of them were volcanic. I was very glad afterwards that I had taken the opportunity, for the beauties and variety of interests in Java, the most thickly populated of these islands, impressed me very greatly.

Java is long and narrow and has an area of about 50,000 square miles, so that it is about the size of England. The population is estimated at 35,000,000, an astonishing number when it is remembered that there are no large manufacturing areas or cities. In some parts of the island there are more people to the square mile than in Belgium, which is the most crowded of European countries.

The population is made up of a wide range of different nationalities. The Javanese themselves are Malays in origin, but during past centuries Hindus, Arabs, and Chinese, particularly the two former, have landed in large numbers and settled in Java

The Hindus established a great Empire in the East Indies and their influence on the people has been most remarkable. In the very centre of Java is one of the most magnificent specimens of Hindu architecture in existence in the form of a ruined temple. It is situated at Borobudur, and is a relic of the times when Buddhism was the prevailing religion of the country. A Moslem invasion followed and the people now are nominally Mohammedans, but apparently this religion has not a very deep hold on them.

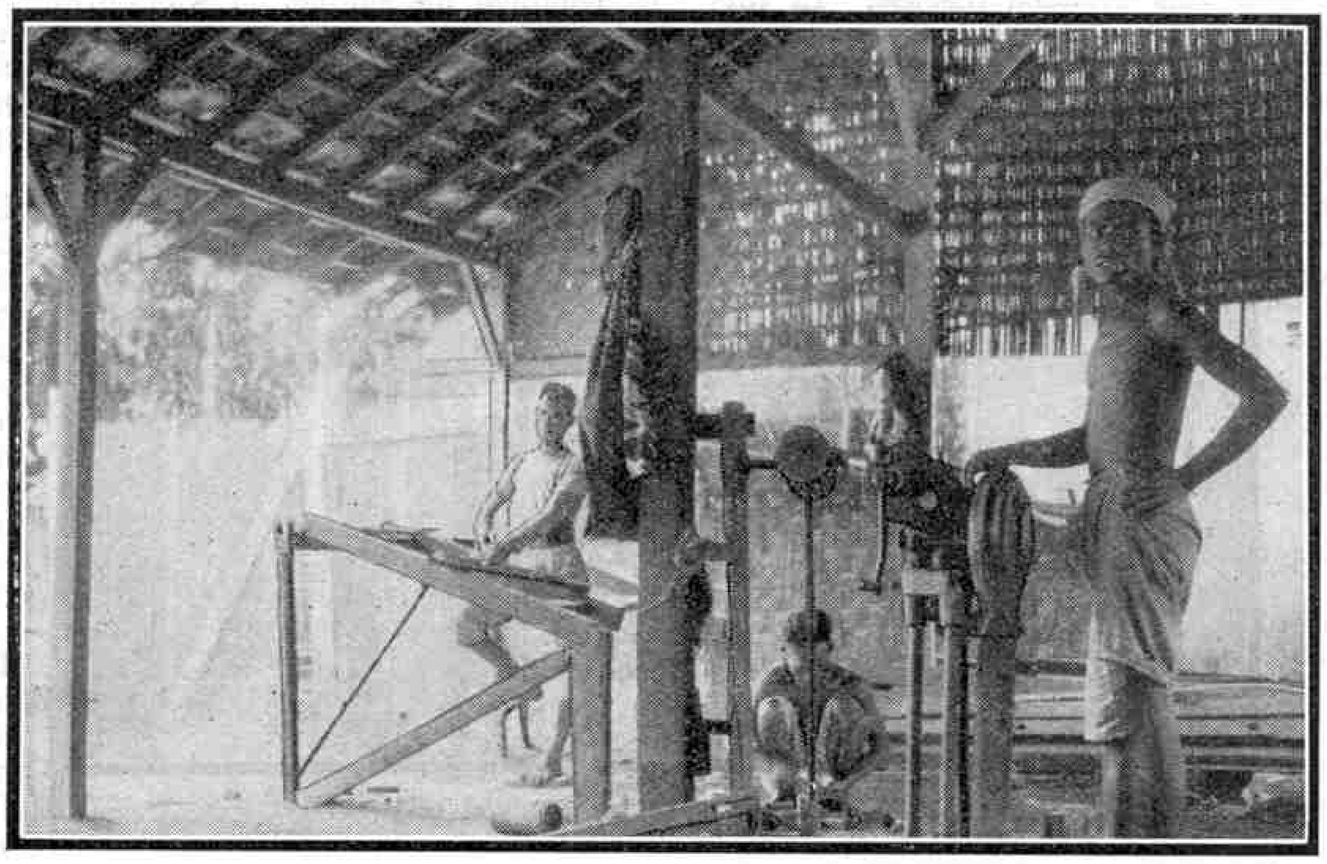
It is not surprising that so many different peoples have been attracted to Java, for it is truly a land of eternal summer. Unbearable summer heat is never experienced in spite of the situation of the island in the tropics. Along the coasts particularly the temperature is comparatively mild and equable, ranging from about 54° F. to 97° F. While this is very pleasant for the visitor, however, it must be said that resident Europeans find the perpetual summer very trying for the constitution. The rainfall is not excessive and with the combination of warmth and moisture the island always presents a green and fresh appearance. It possesses a rich store of valuable products. Its rice fields make it the granary of the East Indies and its coffee and sugar plantations are a perpetual source of wealth.



The marvellous carvings on the terraces of the Borobudur Temple

The voyage of 532 miles from Singapore to Java took about 36 hours. I landed at Batavia, the chief town in Java and the capital of the Dutch possessions in the East. This town was founded over 300 years ago and is well built with picturesque and commodious suburbs. The steamer remained here eight hours before proceeding along the coast of the island. My plan was to go with it as far as Sourabaya, the second largest town, and to return to Batavia by motor-car. This involved a journey of 800 miles over the whole length of Java and gave me a splendid opportunity of seeing this wonderful country.

The start from Sourabaya was very pleasant. The roads were good, usually wide, and bordered on each side by very tall, stately and luxuriant trees backed by feathery palms, which seemed to exist simply for decorative purposes. The picturesquely dressed natives moved and stood in statuesque poses, making the whole scene in the brilliant sunshine one of majestic beauty. This type of scenery exists practically throughout the whole of Java. Even the dwellings add to the beauty of the scene, being built back from the road in the plantations of palms to afford them as much protection as possible from the rays of Sun.



A Javanese mechanic at work with a hand-power lathe

My first night was spent at a place called Djokja, and on the following morning I made a visit to the market place, where all kinds of wares peculiar to the country were being sold. These included medicinal herbs, fruits strange to England, all sorts of fancy sweetmeats made from rice, brown sugar tapped from particular palm trees, native-grown tobacco and the main products of the country. All these combined with the picturesque costumes of the vendors to make a most attractive picture.

Djokja is an important town where Javanese customs are more strongly adhered to than elsewhere on the island. It is built on the ruins of an ancient Malay city that was the capital of a native state of the same name. This remained independent under native sultans, who gave great trouble to the Dutch until as late as last century. Now the district is particularly noted for the high quality of its tobacco.

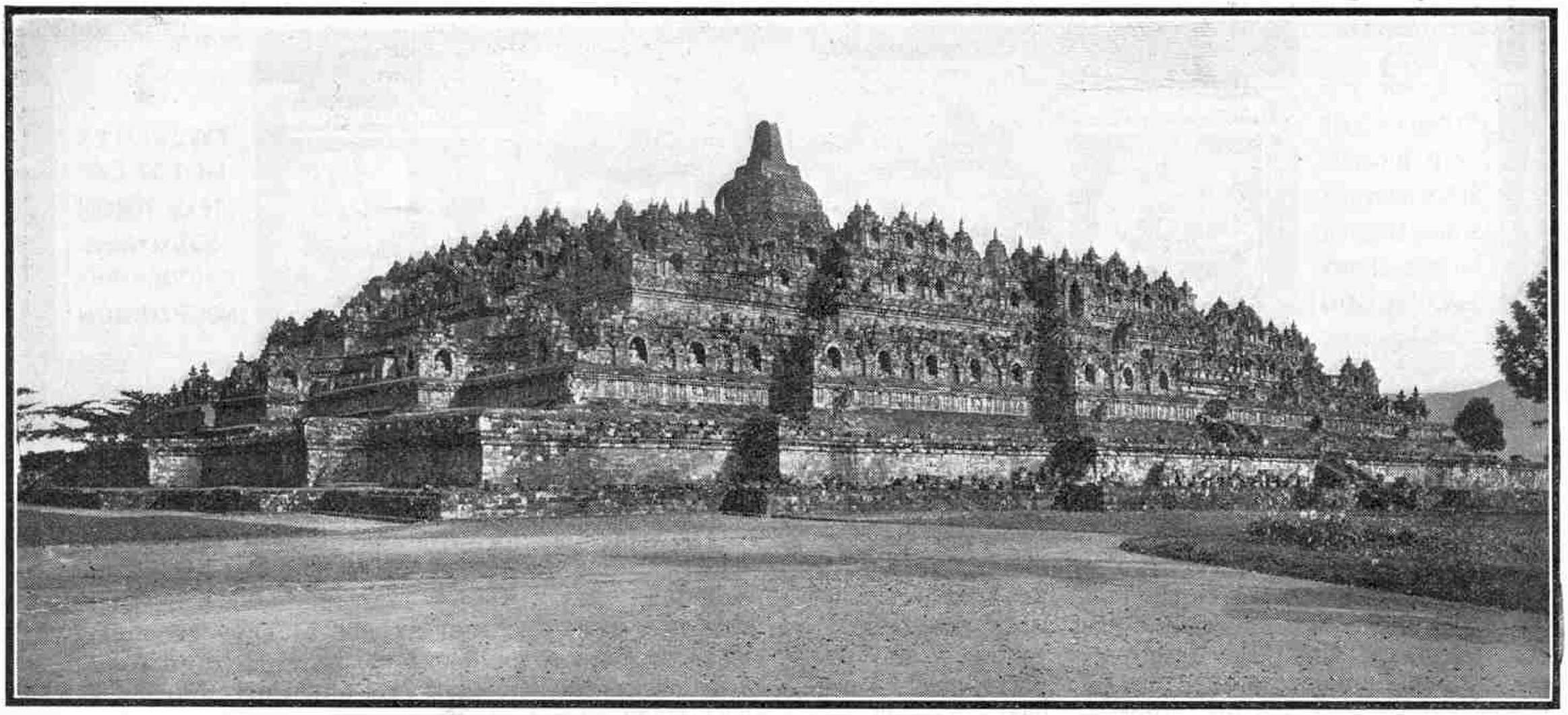
I found that Djokja was a convenient place from which to visit the magnificent ruins of the Borobudur Temple already mentioned, and accordingly I proceeded there. As I approached I saw that it was a huge building, shaped like a flattened half globe. Closer examination showed that it consists of a series of terraces built above each other with a bell-shaped erection rising from the middle of the upper terrace. Hundreds of life-size statues fill niches in the terraces and galleries, while adorning the supporting walls are millions of wonderfully carved reliefs depicting various episodes in the life of Buddha. On the highest terrace are innumerable bell-shaped ornaments of great size and in the centre is the principal temple building containing an image of Buddha.

To find such a remarkable example of early Hindu architecture in the centre of Java is surprising. Its origin is almost certainly Buddhistic. The followers of Buddha assert that after cremation his ashes were divided among eight towns and buried in tombs. Seven of these tombs were afterwards opened by order of Asoka The Great, the most famous of Hindu Emperors, and the ashes distributed in 84,000 stone or metal urns. Wherever a new settlement of Buddhists was formed one of these urns was buried and a memorial monument erected on it, and that place was then worshipped as the grave of Buddha himself. These monuments were called stupas and in their simplest form were half globes.

Later more ornamental forms were developed and of these the temple of Borobudur is undoubtedly the most magnificent ever erected. The Sanskrit character used in the inscriptions shows that it was built about 850 A.D. Thus more than eleven centuries have passed over this colossal building!

The temple was neglected after the downfall of the Hindu Empire in Central Java and all knowledge of the existence of the monument was practically lost until last century. In the meantime earthquakes, volcanic eruptions, tropical rains and heat have assisted its decay. Even yet, however, the ruins are extraordinarily impressive and testify to the skill of the unknown builders and artists responsible for its erection.

Proceeding on my way through the country I saw the natives



The wonderful Temple of Borobudur built 1,100 years ago by Hindus

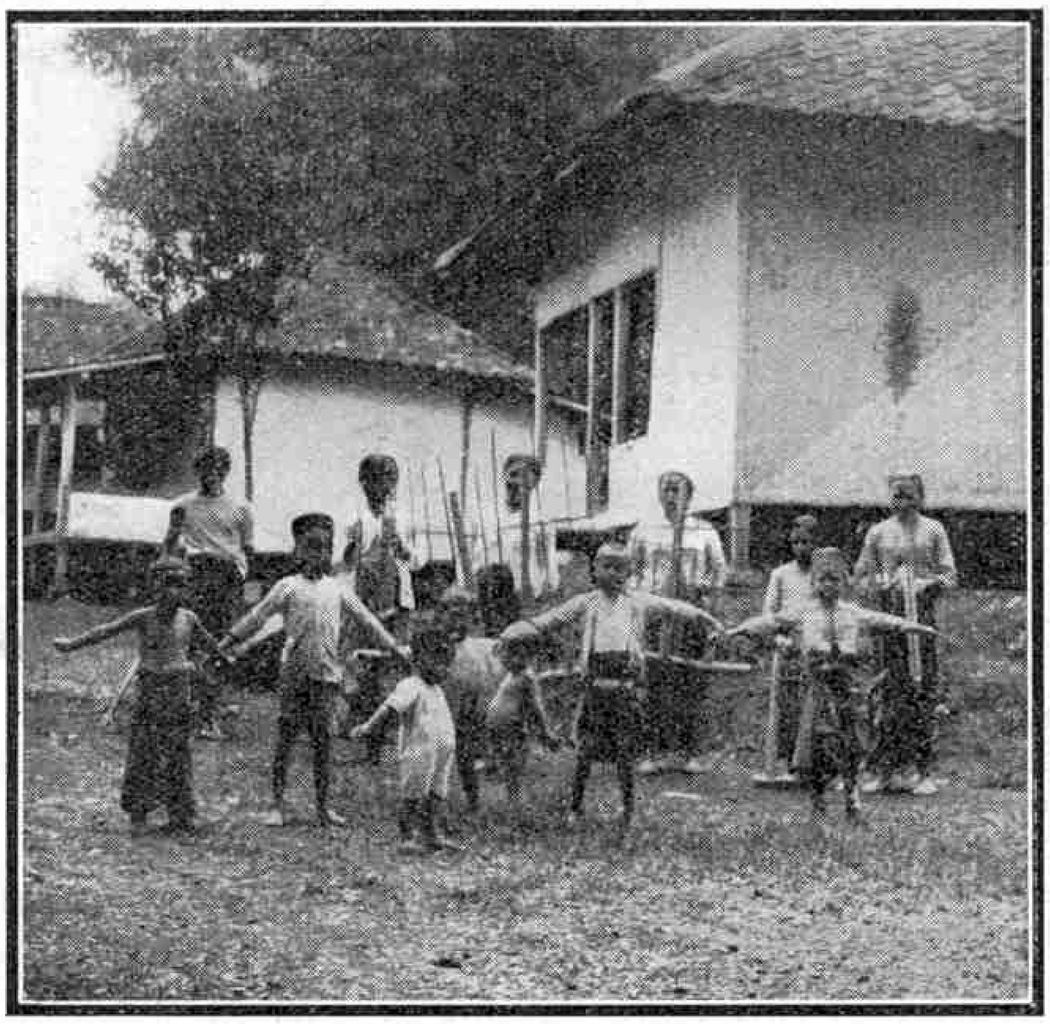
busily engaged in the rice swamps. Rice is the most important cereal here as in most Eastern countries, and its cultivation is carried on in the usual "mud-larking" fashion. Water buffaloes are employed in tilling the ground. As water is their natural element they take a particular pleasure in wading through the muddy swamps and cleaning themselves afterwards by plunging into the rivers.

Farther on I passed extensive coconut and sugar plantations, and also plantations of tea, cocoa and coffee. Even the popular peanut beloved of most boys is grown here, and there are vast areas under cultivation. It was interesting to me to learn that these peanuts grow at the roots of plants in the same manner as potatoes and are dug up with forks. From their name and appearance it would be thought that they grow on trees.

Subsequently I had an opportunity of inspecting a small factory where Citronelle oil was extracted. This factory is located in a vicinity where the grass from which the oil is extracted is largely grown. In the process of production the grass is cut and dried in the sun, after which it is placed in large iron cylinders where the oil is extracted by superheated steam. The oil is used largely for the manufacture of soaps and perfumes.

I made a short stay in a coconut plantation, where my guide induced one of the natives to obtain a young coconut from one of the palm trees. The milk obtained from it proved to be especially refreshing, but I was more interested in watching the native climb the tall palm. To enable him to do this more nimbly he connected his ankles by a short piece of rope thus obtaining a better grip on the trunk of the tree while climbing.

On leaving the plantation I proceeded to a little out-of-the-way village near a thickly wooded palm grove. This was an unspoiled native village where I saw Javanese life in its native simplicity. There were only a few native dwellings but the number of children was surprising. I was entertained to native folk dances by these children to the music of a native-made instrument called the Ankloeng-Speler, played by their elders. This instrument is made with three different lengths of bamboo resembling the pipes of an organ and fastened loosely in a frame-work, and when shaken produces very melodious sounds. It was a novel experience to see these dances, and one that I shall remember with a great deal of pleasure on account of the novel surroundings. I made quite a stay in this village and secured several good photographs. Before leaving I went into one of the houses and saw two women weaving cloth on a native loom of the most primitive kind, consisting mainly of bamboo poles obtained in the locality. In spite of this crude machine, the cloth was of excellent quality and finish.



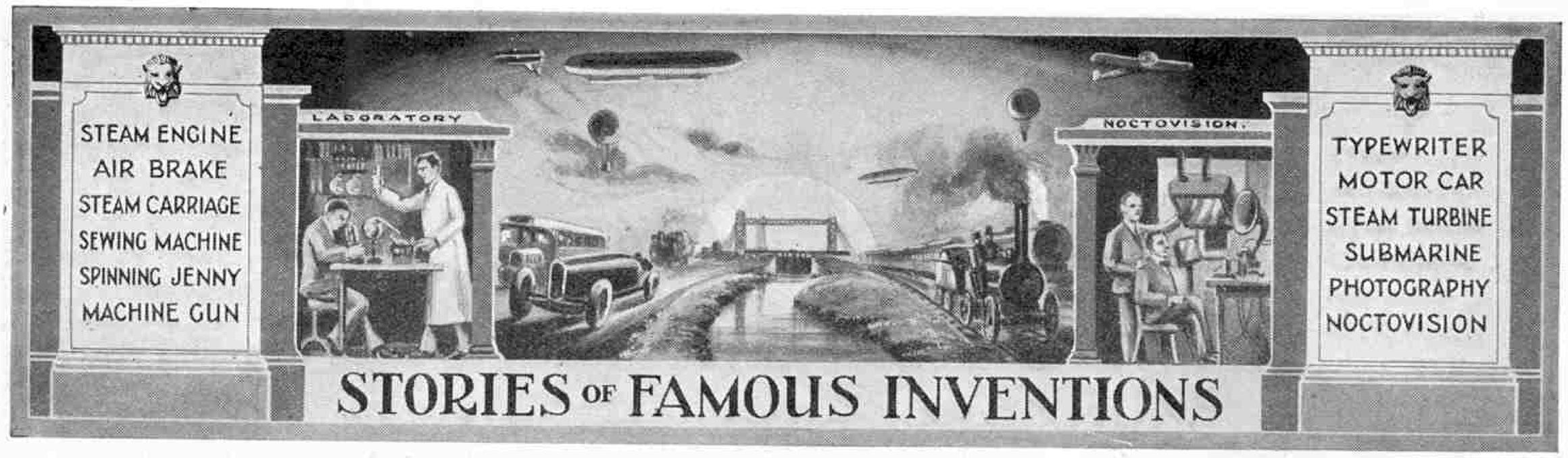
Children dancing in a Javanese village

Resuming my journey, I was fortunate in being able to inspect a native factory where sago and tapioca were being made. The former is made from a species of palm tree. This is cut down when it is about 15 years old and the starchy pith extracted and grated to a powder. The sago is separated from the woody fibre by kneading with water over a strainer through which it passes, leaving the fibre behind. It is then washed, mixed into a paste with water and rubbed through sieves to reduce it to small grains. Tapioca is another starchy product obtained from the root of the cassava plant. After separation from the fibrous matter in much the same manner as sago it is heated while moist. This causes the starch granules to burst and swell into almost transparent pellets.

Several times on my journey I was reminded that Java was a volcanic island. There is in fact no region in the world of equal extent in which so many active volcanos are to be found, most of these being clustered together in the centre of the island. The loftiest is named Sensera, and is 12,238 ft. in height.

The volcanic character of the country is also shown by the occurrence of sulphurous hot springs and geysers in various places. The geysers are not very numerous, but a group of seven at Tjislok on the south coast of the island are of special interest as they are all situated in the bed of a small river. The largest sometimes attains a height of 10 to 12 ft. The water poured forth by all seven is very hot and thus a hot and a cold bath are afforded at the same place. Near the geysers is a resthouse where visitors may stay overnight.

The end of my pleasant journey through Java came only too early, and I returned to Singapore. *(To be continued)*



I.—THE TYPEWRITER

VERY few inventions of any importance can be said to be definitely the work of one man. As a rule one inventor evolves the basic idea and works it out in a more or less crude form, and subsequently the defects of this first design are removed one by one by other inventors until ultimately the mechanism is perfected and plays an important part in everyday life. The typewriter is a typical example of the evolution of a wonderfully perfect machine by the successive efforts of many inventors.

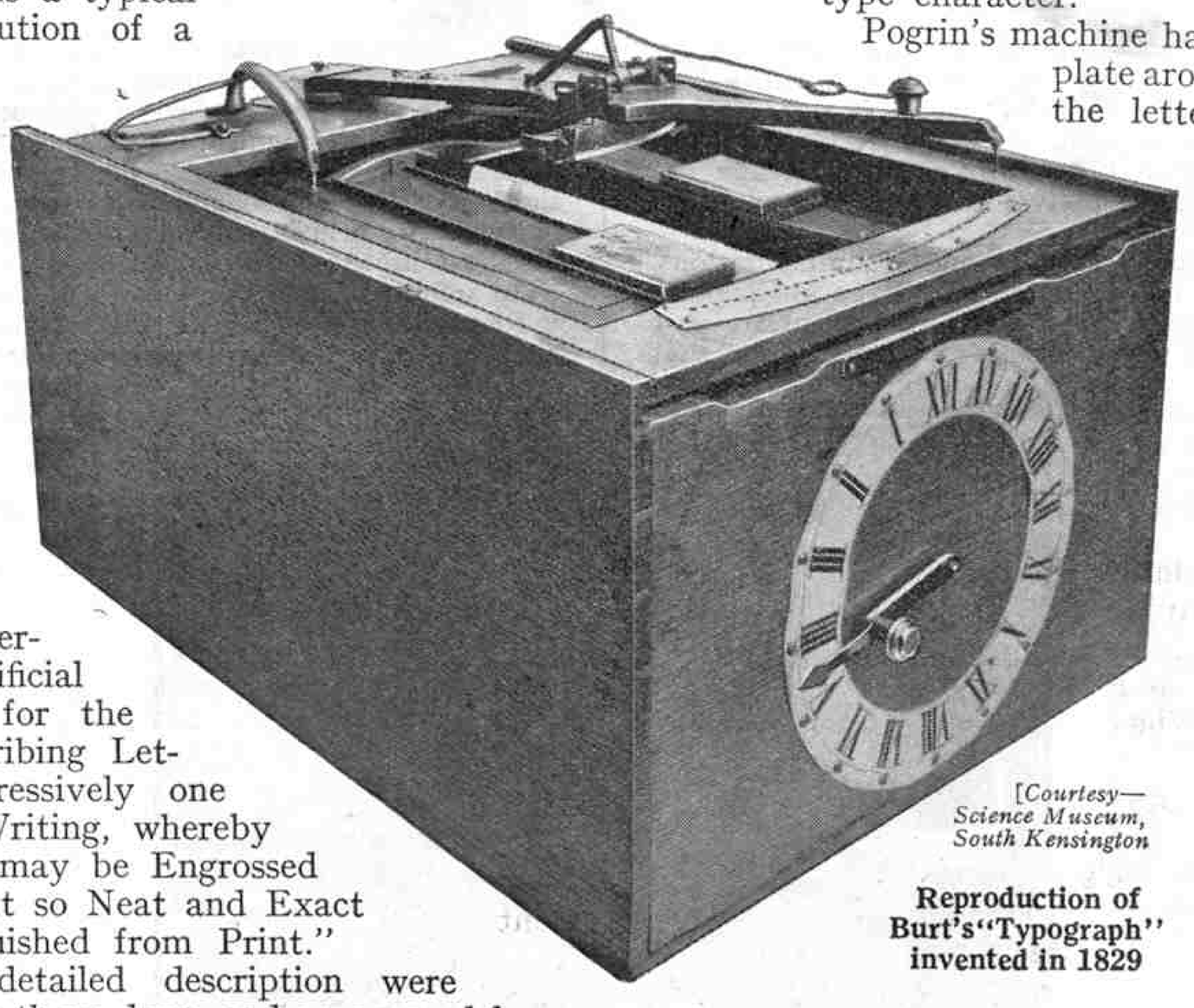
The history of the typewriter may be said to have begun on 7th January, 1714, when a patent was granted in England to an engineer named Henry Mill, for a contrivance "that he has by his greate study, paine and expence lately invented and brought to perfection. An Artificial Machine or Method for the Impressing or Transcribing Letters Singly or Progressively one after another as in Writing, whereby all Writing whatever may be Engrossed in Paper or Parchment so Neat and Exact as not to be distinguished from Print."

No drawings or detailed description were attached to patents in those days, and as no model of Mill's invention exists, nothing is known as to the construction and operation of his machine. The declaration of the patent goes on to remark that "the said Machine or Method may be of greate use in Settlements and Public Recors, the Impression being deeper and more Lasting than any other Writing, and not to be erased or Counterfeited without Manifest Discovery."

Mill's patent was declared valid "for the term of fourteen yeares."

More than a century elapsed before another attempt was made to devise a practical letter-writing machine. On 23rd July, 1829, William Austin Burt of Detroit, U.S.A., patented a machine called a "typographer." The model and specification of this machine were unfortunately destroyed in the disastrous fire that occurred at the American Patent Office in Washington in 1836.

The next step forward was made in France, in 1833 when Xavier Pogrin of Marseilles patented what he called a "ktypographic machine or pen." Although this invention does not appear to have been adopted to more than a small extent, it represented a distinct advance on the efforts of Mill and Burt, and it was the first typewriter to have a separate key lever for each type character.



[*Courtesy—Science Museum, South Kensington*

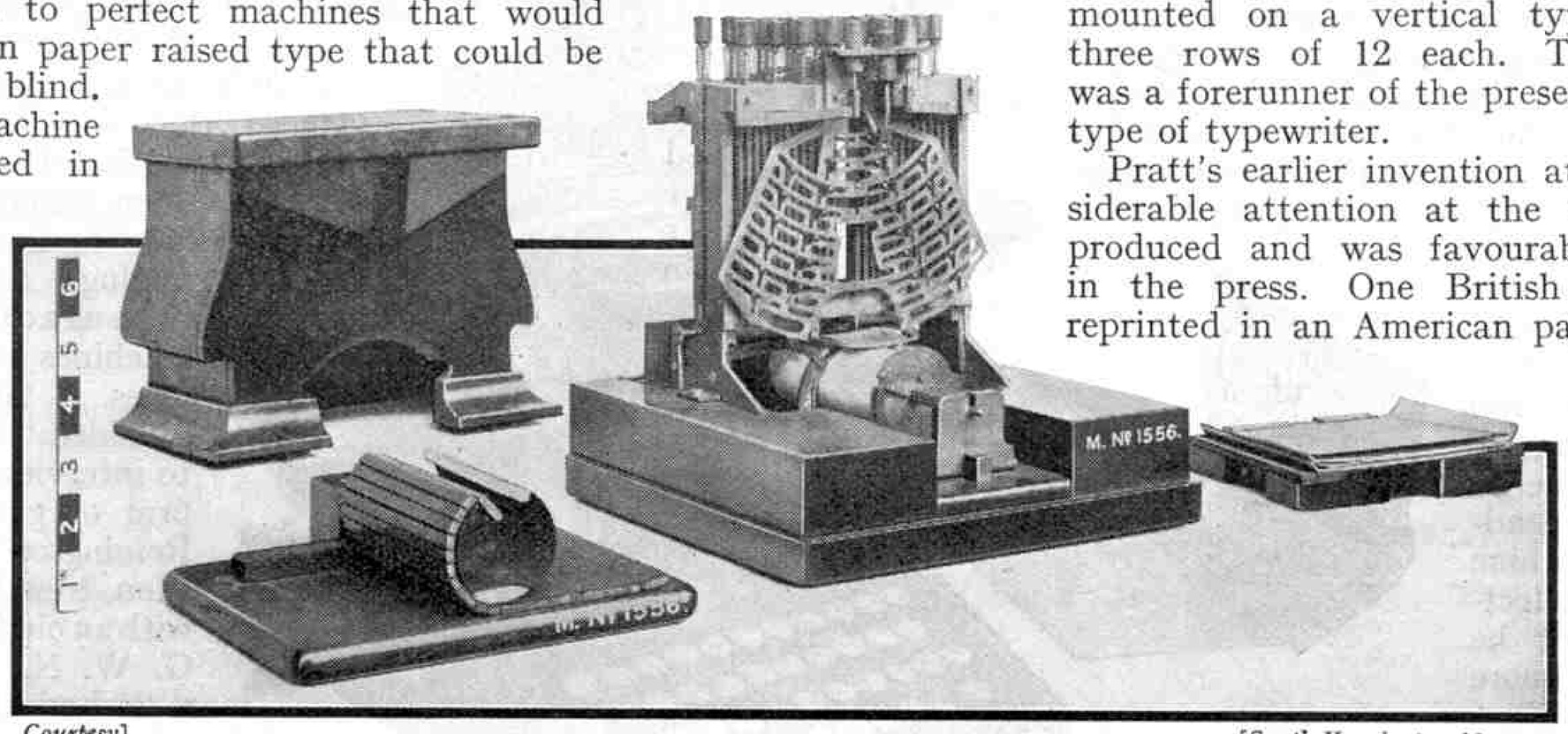
Reproduction of Burt's "Typograph" invented in 1829

Pogrin's machine had a circular horizontal plate around which were marked the letters, figures, etc. The key levers were arranged in a vertical position around the disc, each one being forked at the base and pivoted to the shank of the type hammer. Each hammer carried a type character corresponding to the one marked on the disc opposite its particular lever, and the hammers were inked by means of a pad. When a lever was actuated, the hammer moved to a central printing point common to all and made its impress on the paper held stationary below. The whole framework of levers was then moved across the paper to the extent of one letter space by means of a rack and pawl, and the next letter was printed. In addition to printing ordinary letters and figures Pogrin's machine also was capable of printing music.

Ten years after Pogrin brought forward his invention, Charles Thurber, an American of Worcester, Mass., patented a machine for writing with type to which he gave the name "Chirographer." This machine had a horizontal wheel in the circumference of which were 44 holes, each holding a vertical rod having a steel type character on its lower end. The wheel was turned until the type letter required was over the printing position, and the rotating of the wheel and rod also caused the type character affixed to the latter to come into momentary contact with a small inked roller attached to the wheel rim at right angles.

The "chirographer" gained distinction from the fact that it was the first machine to embody a platen cylinder for the paper which was held down by clips. This cylinder was situated in front of the wheel, and was moved in a rotary direction by means of finger pawls working into ratchets at the cylinder ends, while manipulation of a handle that projected from one side of the frame of the machine moved the cylinder longitudinally on its axis rod. The advantages of this original roller feed whereby the unused paper was fed to the printing centre were considerably diminished by the fact that it was necessary for the operator to carry out the longitudinal and rotary motions of the mechanism one at a time, which considerably decreased the speed of operation.

About this time various inventors were engaged in attempts to perfect machines that would impress upon paper raised type that could be read by the blind. Such a machine was patented in America about 1847 by Alfred S. Beach of New York, editor of the well-known magazine "*Scientific American.*" This machine included a blank key by means of which spaces could be registered between words, and a small bell that rang when the typing mechanism was nearing the end of a line. Both these items are embodied in every modern typewriter, as are small letters in addition to capitals. This last feature first made its appearance in 1856 in a telegraph typewriter that translated Morse into English or vice versa, constructed by Sir Charles Wheatstone, the famous pioneer of telegraphy.



Courtesy] **Wheatstone's Telegraph Typewriter invented in 1856** *[South Kensington Museum*

It is of interest to note how the development of the typewriter went forward first in one country and then in another. Wheatstone's achievement in England in 1856 was followed a year later in America by the patenting of a typewriter invented by a wealthy New York doctor named S. W. Francis. This machine was a very complicated affair in which the type keys that actuated the type rods were arranged after the style of a pianoforte keyboard, and were connected to the rods by trip-gear mechanism. The rods were arranged in a circle and when operated they thrust the type to a common printing centre. After the typing of each character a spring released the carriage sufficiently to enable this to travel to the left for a distance of one type space. The machine incorporated various devices introduced on earlier typewriters, such as the space key and the line bell.

Although great strides forward had been made by this time, the typewriter was still crude and clumsy, and many further improvements had to be made before a speedy, efficient and compact machine became a reality. About the year 1866 an American named John Pratt patented in London a typewriter to which he gave the extraordinary name of "Pterotype," apparently inferring that the machine had wings! Pratt's machine embodied a truncated cone having 22 slots in its sides and in each slot moved freely a type rod bearing a type character on its upper end. The apex of the cone served as the common printing point. The machine was complicated and, although it is said to have embodied some feature of Beach's typewriter, there is no evidence that Pratt knew anything of the latter machine.

Pratt secured the aid of a Glasgow scientific instrument manufacturer in constructing a model of his invention and this was completed in 1865. In the following year he abandoned it, however, in favour of his second invention, which was a machine having 36 characters mounted on a vertical type roller in three rows of 12 each. This machine was a forerunner of the present-day wheel type of typewriter.

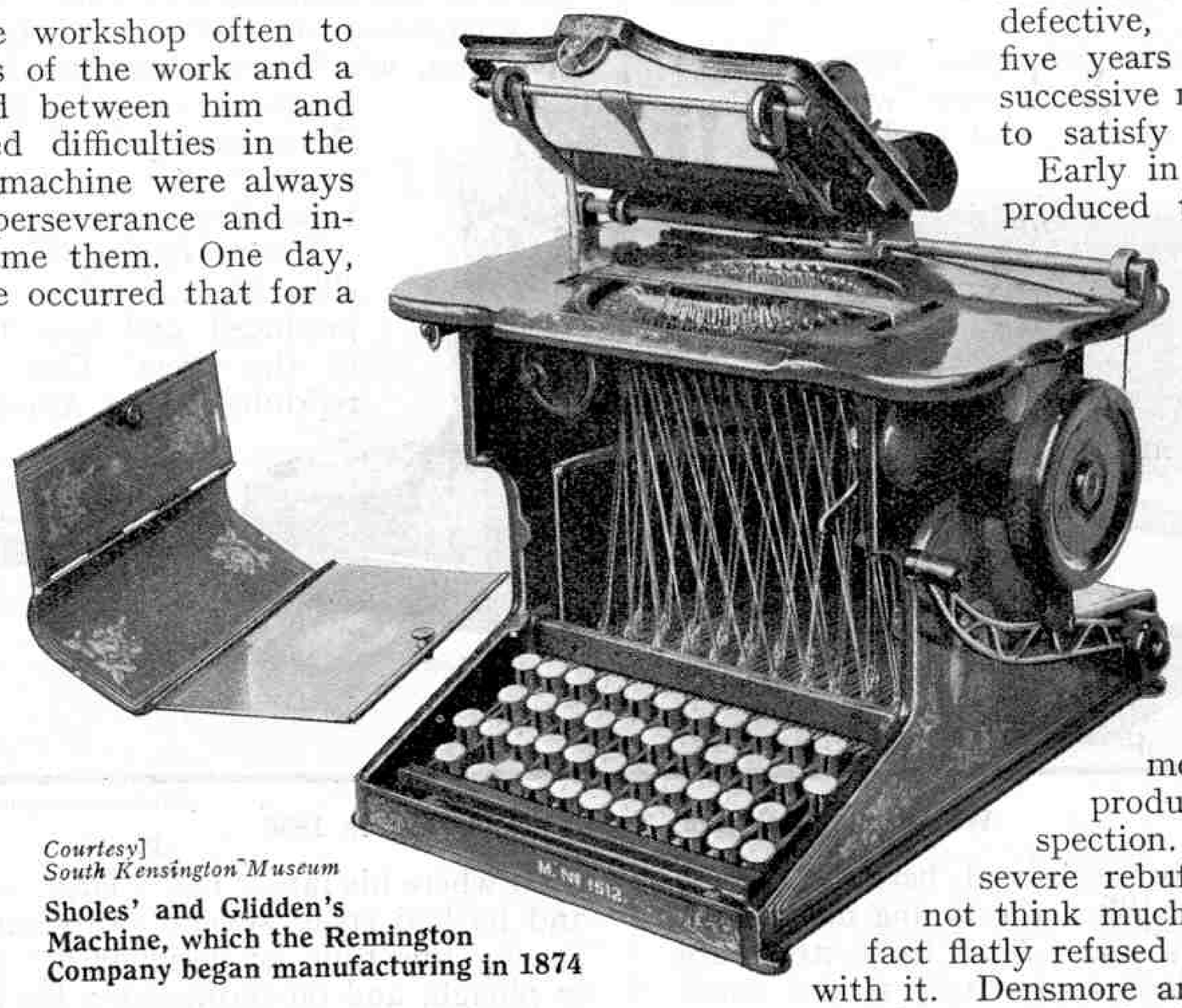
Pratt's earlier invention attracted considerable attention at the time it was produced and was favourably reviewed in the press. One British report was reprinted in an American paper and one day this report caught the eye of a Milwaukee mechanic named Carlos Glidden. Glidden was a native of Ohio where his father had a large ironmongery business, and he had spent several years farming in Wisconsin. During this time he designed a "mechanical spader" or plough, and on terminating his farmwork he visited Milwaukee in search of an engineer enterprising enough to undertake to build a model of his invention. After many fruitless inquiries he came upon a small workshop in which he found a mechanic engaged in constructing a machine for numbering in type. The two men took a liking to each other, and soon it was arranged that Glidden should share the workshop and its equipment and attempt himself to build his spader. This arrangement proved very successful. Each became interested in the work of the other, and whenever either encountered some specially difficult problem the two combined forces until the trouble was overcome.

Glidden found that the numerical typewriter was being built for a man named C. L. Sholes, collector of Customs at Milwaukee, and joint inventor of the machine with Samuel Soule, a local farmer. In addition to their main vocations Sholes and Soule conducted a successful printing and bookbinding business, while Sholes was also a capable editor. A good deal of their trade consisted in the compiling of ledgers and other books used in office routine. The pages of these books were not numbered, and one day the partners discussed seriously the possibility of producing books with numbered pages, which obviously would be a great improvement. They recognised that the printing of the necessary different number on each page of a book would involve an enormous amount of type setting and would

render the finished production very costly. A new machine that would do this special work quickly, correctly and cheaply was required, and at the moment no such machine was in sight.

The discussion ended, but the matter lingered in Soule's mind for the rest of the day. On arriving home that night he made a rough plan of a machine for numbering pages serially and next day he showed the sketch to his partner, who was greatly impressed with it. Various improvements were made to the drawing as the result of careful consideration, and at length a finished plan was carefully drawn up and the mechanic whom Glidden met later undertook the task of building the machine.

Sholes visited the workshop often to observe the progress of the work and a friendship developed between him and Glidden. Unexpected difficulties in the construction of the machine were always cropping up, but perseverance and ingenuity soon overcame them. One day, however, an obstacle occurred that for a time defied the combined skill of all concerned, and then it occurred to Glidden that too much thought, labour and energy were being expended upon a machine that, when perfected, would not be able to do more than type numbers. "Why don't you try to make a machine that will write letters instead of figures only?" he asked.



Courtesy]
South Kensington Museum

Sholes' and Glidden's Machine, which the Remington Company began manufacturing in 1874

At the moment Sholes was too engrossed in the problem of a numbering machine to consider anything else. Some months later, however, Glidden, as we have seen, chanced upon the newspaper account of Pratt's invention and showed it to Sholes, who then realised the enormous possibilities of a typewriter for all-round purposes as compared with a mere numbering machine.

The numbering machine was now put on one side and Sholes and Glidden set to work to devise a thoroughly efficient typewriter. Gradually the details were worked out, drawings were made and by September 1867 a working model had been built. In this machine, which in many respects was a great improvement on that of Pratt, the letter type was in capitals only. The arrangement of the type rods followed the plan adopted in earlier machines, the rods being arranged in a circle and each moving pivotally towards a common printing centre. The machine worked fairly well and its inventors were so delighted with their success that they wrote letters by means of it to many of their friends as evidence of the efficiency of their machine.

Among those who received one of these letters was a retired editor and printer named James Densmore, then residing at Meadsville, Pennsylvania. Densmore was quick to perceive the possibilities of the machine and he promptly offered to repay the experimenters the whole cost of their experiments up to that time and subsequently, as the purchase price of an interest in the invention. Sholes knew Densmore to be a sound business man and accepted the offer at once.

The enthusiasm of Sholes and Glidden received a severe setback some six months later when Densmore, after having thoroughly examined the machine, declared it to have so many serious defects that from a practical point of view it was useless. Glidden was so disgusted that he withdrew from the scheme, but Sholes realised that the criticism was justified and set about building an improved machine incorporating certain features that Densmore declared to be essential. This second machine also was declared to be defective, and during the next five years Sholes built some 30 successive models in the endeavour to satisfy his exacting partner!

Early in 1873 a typewriter was produced that satisfied even the critical Densmore, who then turned his attention to the problem of finding someone to manufacture such machines in large quantities. After careful consideration he decided to interview the famous firm of gunmakers, E. Remington and Sons, at Ilion, New York. Along with an old friend named G. W. N. Yost, Densmore visited the firm and produced his machine for inspection. At first he received a severe rebuff. The gunmakers did not think much of the machine and in fact flatly refused to have anything to do with it. Densmore and Yost were not to be beaten, however, and after a long and skilful persuasion they induced the firm to agree to manufacture the machine. Not only this, but the gunmakers undertook to devote the firm's vast resources freely to improving the machine as much as possible.

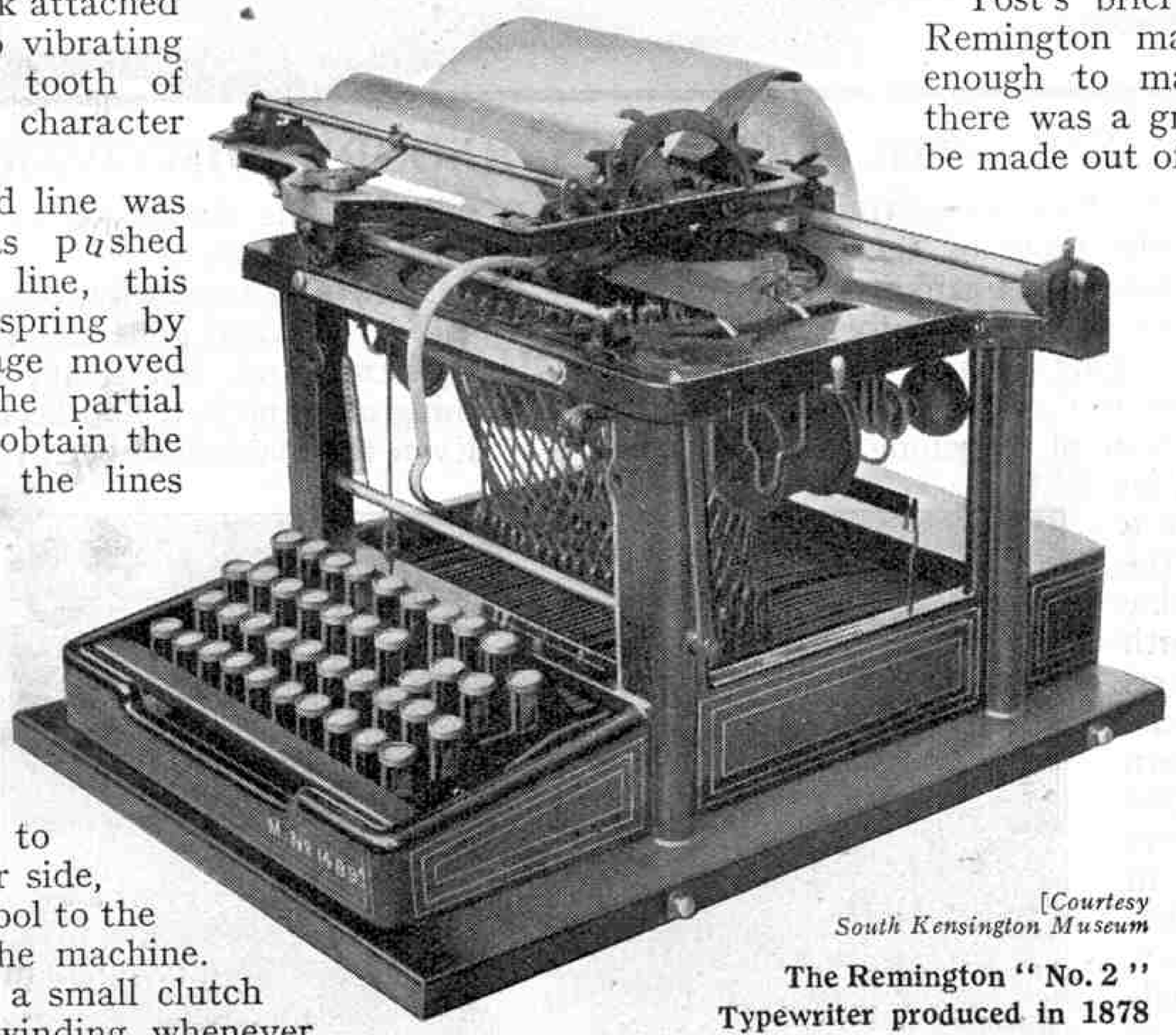
In spite of the large number of improvements effected by Densmore and Sholes the typewriter was still crude in many respects, and Remingtons' found it necessary to re-design it before they could satisfactorily commence to manufacture it. The task proved long and costly, but the company loyally kept their promise to carry out such improvements as might be necessary, and late in 1874 the first "Remington" typewriter was produced and placed on the market. This machine was the first really practical typewriter, and it is significant that the principles of its construction are still closely followed in modern machines.

The "No. 1 Remington" had 44 type keys, which included capital letters but no small ones. The keys were connected by means of horizontal levers and vertical wires to a corresponding number of type bars, all of which were hung vertically around a circular opening in the top of the machine frame. Each type-bar carried one type character only, and when in use thrust this upward to a printing centre common to all the type characters. The type-letter keys were arranged on a keyboard in three rows, a higher

row containing numerals, etc. This arrangement of the characters has been adopted for practically all modern typewriters, and it is known as the "Universal" keyboard.

The cylinder around which the paper to receive the type impressions was partly wound rested on a horizontal carriage or cradle that slid easily along by means of a rod at the rear and a supporting small wheel at the front. Any width of paper up to $8\frac{1}{4}$ in. could be accommodated on the cylinder, under which it was first passed and then held in place by two rubber bands that passed round small narrow rollers on the carriage. A spring fitted in the left part of the machine exerted a pull upon the carriage, but the latter was prevented from running away by a rack attached to it and engaged with two vibrating detents that released one tooth of the rack after each type character was struck.

When the end of a typed line was reached, the carriage was pushed back ready for the next line, this motion winding up the spring by means of which the carriage moved along during typing. The partial rotation of the cylinder to obtain the required spacing between the lines was effected by an external lever arranged at the right-hand side of the machine and connected to the cylinder by a cord. A ribbon was stretched across in front of the cylinder from a spool on one side of the machine to a second spool on the other side, and was wound from one spool to the other by the working of the machine. The movement by hand of a small clutch reversed the direction of winding whenever a spool became empty.



[*Courtesy South Kensington Museum*

The Remington "No. 2" Typewriter produced in 1878

In order to advertise the capabilities of the new typewriter, Densmore and Sholes caused samples of its work to be distributed far and wide, but the response was most discouraging. An attempt to attract public attention to the merit of the machine by exhibiting it at the Centennial Exhibition at Philadelphia, in 1867, was little more successful, and eight years elapsed before the sales began to make appreciable progress.

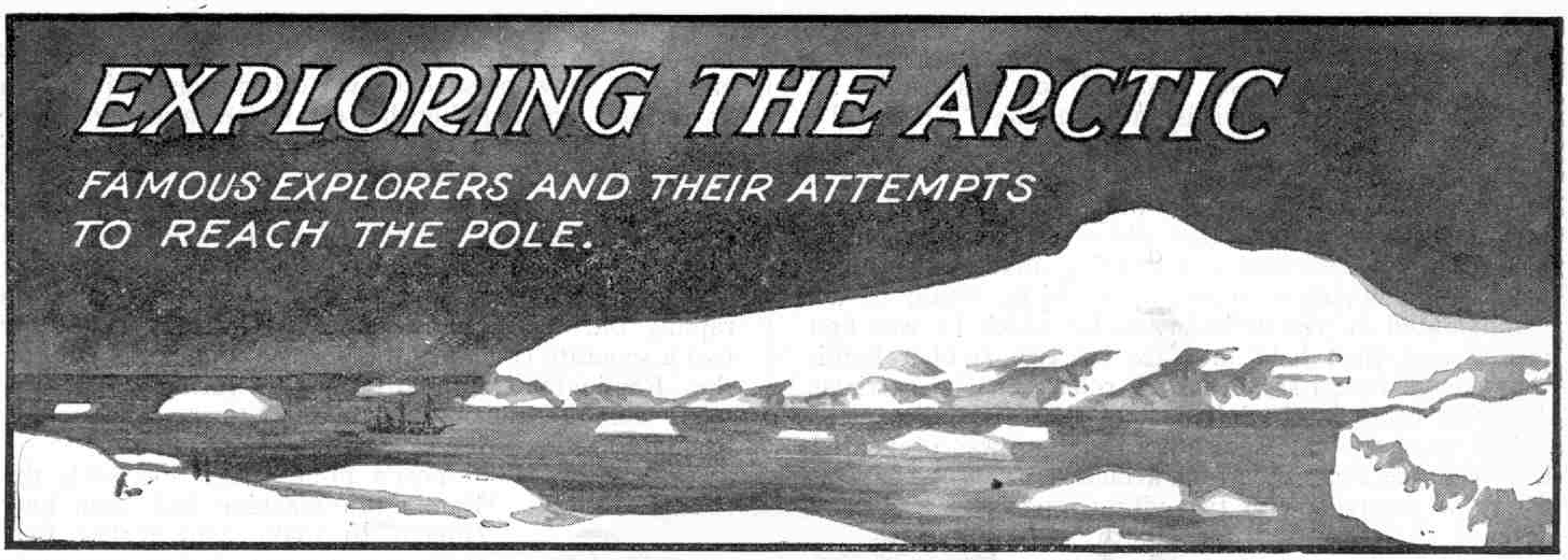
During this period the manufacturers were not idle and many improvements were brought about in the design and construction of the machine. Thus the "No. 2 Remington" produced in 1878 had 76 characters, provided by equipping 38 of the 40 type-bars with two characters each. This improvement brought about the introduction of two shift keys by means of which the carriage bearing the platen cylinder could be raised or lowered so as to bring into contact with the paper whichever of the two rows of type characters was required. By turning a handle in the front of the machine the carriage could be raised sufficiently above the machine frame to enable the typed matter to be inspected, and the same device also served to rotate the cylinder sufficiently to present a new line when this was required.

So successful were the early attempts to sell the machine that at length Densmore withdrew from the business. Yost, who had associated himself with the enterprise, now persuaded two other men to join him as partners, and together they established a selling agency under the name, Locke, Yost and Bates. This venture failed, however, and the partners were only too glad to sell out to another company and retrieve as much as possible of their lost capital. About 1884 the Remington Company themselves took over the sale of the machine and from that time onward success was assured. So rapidly did the trade develop that within a year or two a separate company was formed under the name of the Remington Standard Manufacturing Company, solely for the purpose of manufacturing and selling Remington typewriters.

Yost's brief association with the Remington machine had been long enough to make him realise that there was a great deal of money to be made out of the typewriter industry. When his selling agency lapsed, therefore, he turned his attention to constructing a machine of his own, and ultimately he devised one having a double keyboard, one portion for small letter type and the other for capitals. This arrangement eliminated the need of a shift key. Yost soon found, however, that the Remington patents were so comprehensive that the prospects of his claim to having invented an original machine were very doubtful, and eventually he applied for and obtained from the Remington firm a license to cover the manufacture and sale of his machine.

In successive "editions" of their typewriters the Remington company continued to effect minor improvements. One of the most important of these was the introduction at one end of the platen cylinder of a small-toothed wheel actuated by a hand-operated lever, one end of which engaged with the wheel teeth. The manipulation of this lever moved the cylinder around to the extent of one, two or three teeth at a time, as set, these ratios representing the three alternative line spacings to be found on all modern typewriters. The raising of the platen cylinder is now done by shift key.

Most present-day typewriters are type-bar machines but there are also index and type-wheel machines. The index-machines have an index plate and pointer by means of which the required type character is brought over the printing point and depressed, usually by a knob. This type of machine is simple, portable and cheap to manufacture, but it is not sufficiently rapid in operation to be of use for commercial purposes. In type-wheel machines the type characters are mounted on the rim or face of a wheel, and the character required is brought around to the printing point by depressing the type key, when the wheel revolves to the necessary extent and the type character is stamped upon the paper.



XVI.—THE FRANKLIN RECORD DISCOVERED

IN the last article in this series the adventures of M'Clintock and the crew of the "*Fox*" during their search for news of the Franklin expedition were related up to the point when M'Clintock and Hobson, the leaders of the sledging parties, parted company. The latter crossed over to Cape Felix, in King William Land, with the intention of searching the west coast, while M'Clintock held on to the south to make a complete circuit of the island and to examine the land near the mouth of the Great Fish River.

In the course of the journey down the eastern shore of King William Land more natives were met. They were in possession of a number of spoons and forks bearing the crests and initials of various companions of Franklin, and these were bought from them for four needles each. Steel needles and small tools are greatly valued by the Eskimos and one of them took so great a fancy to a saw that he picked it up and held a knife out in front of him in exchange. Mistaking this for a threat to stab M'Clintock, one of the men rushed out of the tent with a gun in his hand, whereupon the Eskimo immediately returned the saw and the entire population of the village swarmed round with protestations of friendship, frequently repeating the words "Kammik toomee," meaning "we are friends."

Captain F. L. M'Clintock

These people are a finer race than those living in North Greenland. The men have their hair cropped short except for one straggling lock on each side of the head, and the women have lines tattooed on their faces. M'Clintock found them to be good-humoured, noisy thieves. Some of them accompanied him for miles on his departure, and he found it very difficult to get rid of them.

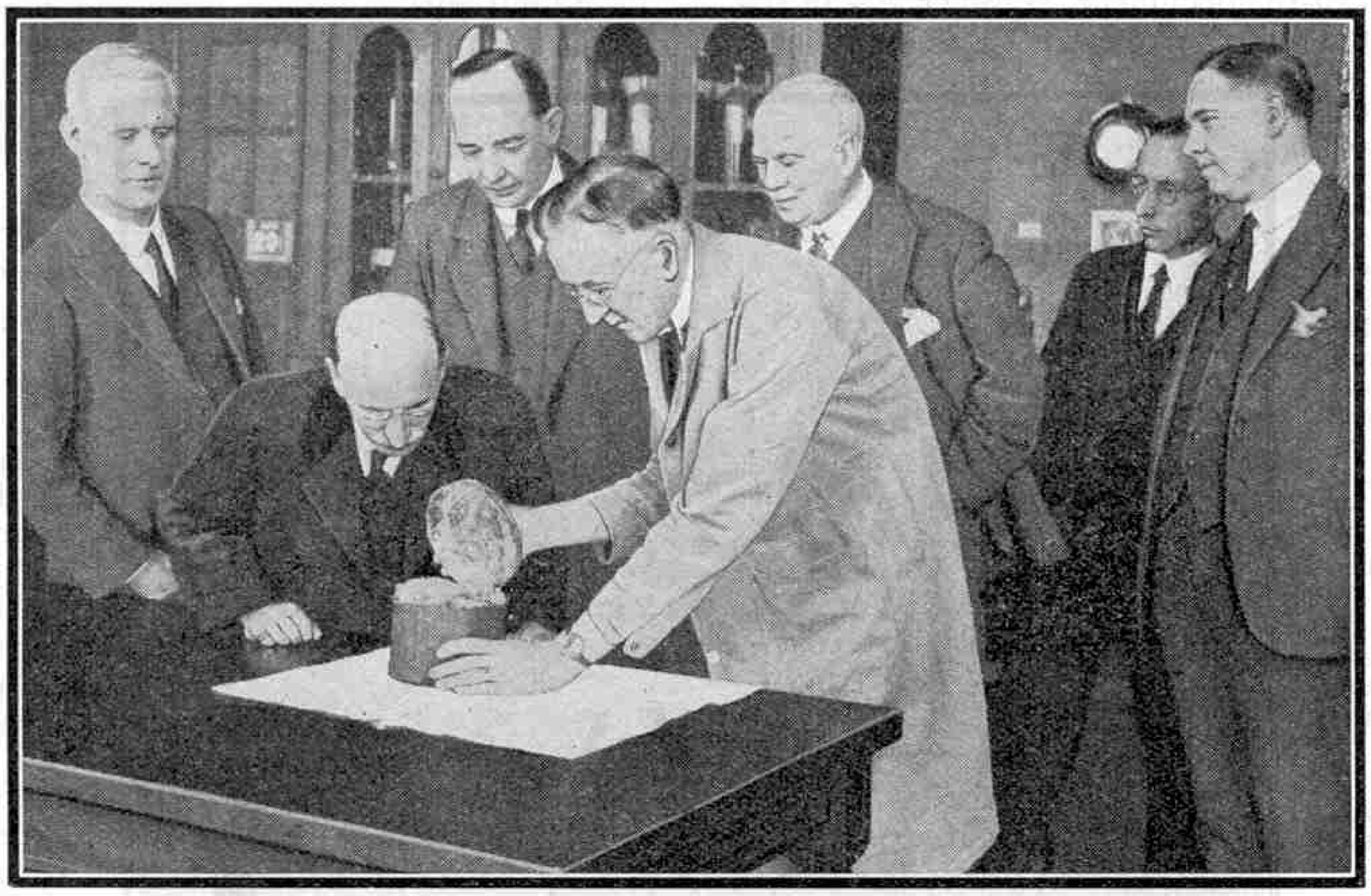
More information was obtained here about the stranded ship. This had gone ashore on the west coast of King William Land, but it appeared that practically everything of value in it had been taken away by the natives. Even the masts had been removed by the crude process of burning them through close to the deck. One old woman said that many of the white men from it dropped by the way on a journey to the south. A few were buried but others were not, and their bones were discovered by Eskimos in the following winter.

An interesting encounter with the inhabitants of a single snow hut occurred a day or two later. A huge pile of blubber, skins of various sorts, and reindeer flesh was in front of the door, and M'Clintock's eye fell with curiosity on a number of poles and other wooden articles that seemed likely to be plunder from one of Franklin's ships. He wished to question the owners, but not liking the look of a fine dog that was tied at the entrance, he was forced to wait for the occupants of the hut to come out. At length an old man and woman appeared, but were so frightened that they could give no information of any value, merely repeating "Kammik toomee," in fear and trembling.

The journey was continued south as far as the mouth of the Great Fish River. A furious gale kept the men in their tents on the ice throughout the whole of the day following, and it was late on the succeeding day before the journey could be resumed. Two marches then brought the party to Montreal Island in the Fish

River estuary, and camp was made on what proved to be a separate island. On it Petersen found a piece of a preserved meat tin with scraps of copper and iron. These were probably part of the plunder of Franklin's ships left here by an Eskimo until required.

Snow fell thickly the next day, 16th May, and the examination of Montreal Island had to be postponed for a day. Then Petersen drove the dog sledge round the shores, while M'Clintock and one of the men walked along the land at different distances from Petersen. Although the most vigilant look-out was kept, nothing connected with Franklin and his crews was discovered. No natives were met with, and the explanation of their absence seems to have been that the season was unusually severe



Opening a tin of beef 80 years old ! This was one of 700 unopened tins found at Franklin's winter quarters on Beechey Island. It had long been supposed that the meat in them was bad, but that in the tin opened at Liverpool on 20th April, 1926, as shown above was found to be quite sound, if a little mouldy outside, in spite of its age and its trip to the Arctic regions

The return journey to the north was postponed for two days owing to the illness of one of the men. When the journey was resumed the sick man was unable to pull, and M'Clintock resigned to him the special dog-sledge. This was an addition to the equipment of the party made almost at the last moment before setting out. The dogs were puppies born on board. M'Clintock had really brought them in the hope of selling them to Eskimos, but had no success in this way.

Driving these animals was no pleasure. They displayed even more than the usual cunning and perversity of sledge dogs in avoiding both work and whip, while one was lame, another one too small, and two of the remainder were mere starvelings. One annoying habit was that whenever the sledge stuck for any reason whatever the dogs showed their delight by lying down and leaving their driver to do all the work of extrication. The leader parted with them without regret and was henceforth free to make any deviation he thought necessary to examine possible remains of the lost expedition.

The route of the return journey was up the west coast of King William Land. Rounding Point Ogle, Barrow's Inlet was searched, but no natives were met with nor were any finds made there. M'Clintock therefore crossed Simpson Strait to King William Land and proceeded westward along the south coast. In order to avoid snowblindness from the glare of the sun-lit snow most of the marching was done by night, and shortly after midnight on 25th May M'Clintock came across a skeleton at the point marked by a cross on the accompanying map. This was lying on its face on the bare ridge top and seems to have been that of a steward or officer's servant. The attitude in which the bones were found confirmed in a melancholy way the truth of the old Eskimo woman's description of the end of the expedition, "they fell down and died as they walked along."

Finally, in a cairn about 12 miles from Cape Herschel a note from Hobson was discovered with information of a great find. This was nothing less than the record of the Franklin expedition, which Hobson had discovered under a cairn at Point Victory on the north-west coast of King William Land.

Map showing the area in which M'Clintock and Hobson discovered the Franklin record shown on page 17 and other relics

This memorable document was one of the printed forms on pale blue paper usually supplied to explorers for the purpose of being enclosed in bottles and thrown overboard to obtain information with regard to the direction of ocean currents. Any person finding such a document is requested to forward it to the Secretary of the Admiralty, this request being printed in six different languages, as may be seen in the photograph of this historic document on page 17. Written on the paper is the information that the "*Erebus*" and the "*Terror*" wintered at Beechey Island and afterwards sailed 150 miles up the Wellington Channel in the hope of finding a passage to the west in that direction. The date of the stay at Beechey Island is wrongly given as 1846-7, instead of 1845-6.

It seems probable that this note was written by Gore, the leader of the party of two officers and six men referred to in the message. This party seems to have been sent forward from the ships with the object of exploring the unknown coastline of King William Land and this record of the expedition's achievements was

deposited by them in a cairn about four miles to the northward of Point Victory. It is a cheerful account of great success. The voyage up the Wellington Channel had never before been accomplished, while the position of the ships at the time the words were written shows that the problem of the north-west passage had been practically solved.

The real interest of the document, however, lies in the tragic story written on the margin 12 months later by another hand :—

"April 25, 1848.—H.M. ships "*Terror*" and "*Erebus*" were deserted on the 22nd April, 5 leagues N.N.W. of this, having been beset since 12th September, 1846. The officers and crews, consisted of 105 souls, under the command of Captain F. R. M. Crozier, landed here in lat. 69° 37′ 42″ N., long. 98° 41′ W. Sir John Franklin died on the 11th June, 1847; and the total loss by deaths in the expedition has been to this date 9 officers and 15 men.
(Signed)
"F. R. M. Crozier,
"Captain and Senior Officer.
(Signed)
"James Fitzjames,
"Captain H.M.S. *Erebus*.
"and start on to-morrow, 26th, for Back's Fish River.

This melancholy intelligence was written by Captain Fitzjames with the exception of the words "and start on to-morrow, 26th, for Back's Fish River." The handwriting shows that this addition was made by Captain Crozier himself.

Thus in the short space of 12 months the character of the expedition had entirely changed. In 1847 there was a prevailing spirit of cheerfulness and of pride in great achievements. Release from the ice as the summer advanced and a continuation of successful exploring work were no doubt looked for, and it seems probable that the members of the expedition were confident of accomplishing the north-west passage at last. In 1848 the outlook had been overshadowed by the death of the leader and the loss of the ships. The prospect before the ships' companies was no longer one of further discovery, but of frantic effort to get out of the Arctic alive.

The original message left by Gore had been sealed up in a canister by soldering, but after the addition of the last message from the unfortunate men who had embarked on the desperate enterprise of marching to civilisation over the inhospitable wastes of northern Canada, the tin was not sealed. The papers were damaged by rust and in a few more years would have been unreadable. This was the last message. All that we know of the doomed men subsequently has been learned from the stories of unreliable natives or deduced from the discovery of a few bones and other relics.

After studying Hobson's news, the journey to the north was resumed. Provisions were running short and the remainder of the puppy sledge team were slaughtered and the sledge used for fuel. The country now being traversed was bleak in the extreme, Eskimos, seals and life of almost any kind being apparently totally absent.

A few days later one of the most melancholy relics of the lost men was discovered on the west coast by M'Clintock. This was a boat 28 ft. in length that had been built with a shallow draft as if for the ascent of the Great Fish River, but was found here mounted on a sledge. In the boat were two human skeletons enveloped in clothes and furs, together with five watches and two double-barrelled guns, one barrel of each being loaded.

Breaking up of the ice on the desolate shore of Baffin Bay

A few books and a large quantity of clothing were discovered also.

An astonishing feature of this discovery was that the sledge was directed toward the north-east and not, as would at first be expected, toward the Great Fish River in the south. This, and the presence of the two men in the boat, suggested that a number of the men had been directed to return to the ship, possibly for more provisions, and that the remainder of the party had gone forward to the ship after leaving the two men in the boat with sufficient provisions to last until their return. It is probable that the two whose skeletons were discovered were too weak to pull the sledge or to go forward with the rest of the party.

Throughout the whole of their journeys along the west coast of the island, both M'Clintock and Hobson kept a sharp look out for the ship reported by the Eskimos to be stranded. It had entirely disappeared, however. Other relics were discovered, but they were of minor importance and only served to confirm the main story.

One fact of great interest that emerged from a study of the record was that Franklin had discovered a north-west passage in 1847, or three years before the discovery by M'Clure. It should be noted also that Franklin's route was more nearly a practicable one, and a study of the general conditions led M'Clintock to express the belief that Franklin would actually have reached Bering Strait if he had known that King William Land was an island. The season of 1846 must have been remarkably open to allow Franklin's ships to sail down Peel Sound, and a passage to the east of King William Land would have sheltered them from the pressure of the ice brought down from Melville Bay by the currents of the M'Clintock Channel. Once safely round King William Land, Franklin would have had a fairly easy journey through straits and seas familiar to him, their shores having been explored by him in previous expeditions.

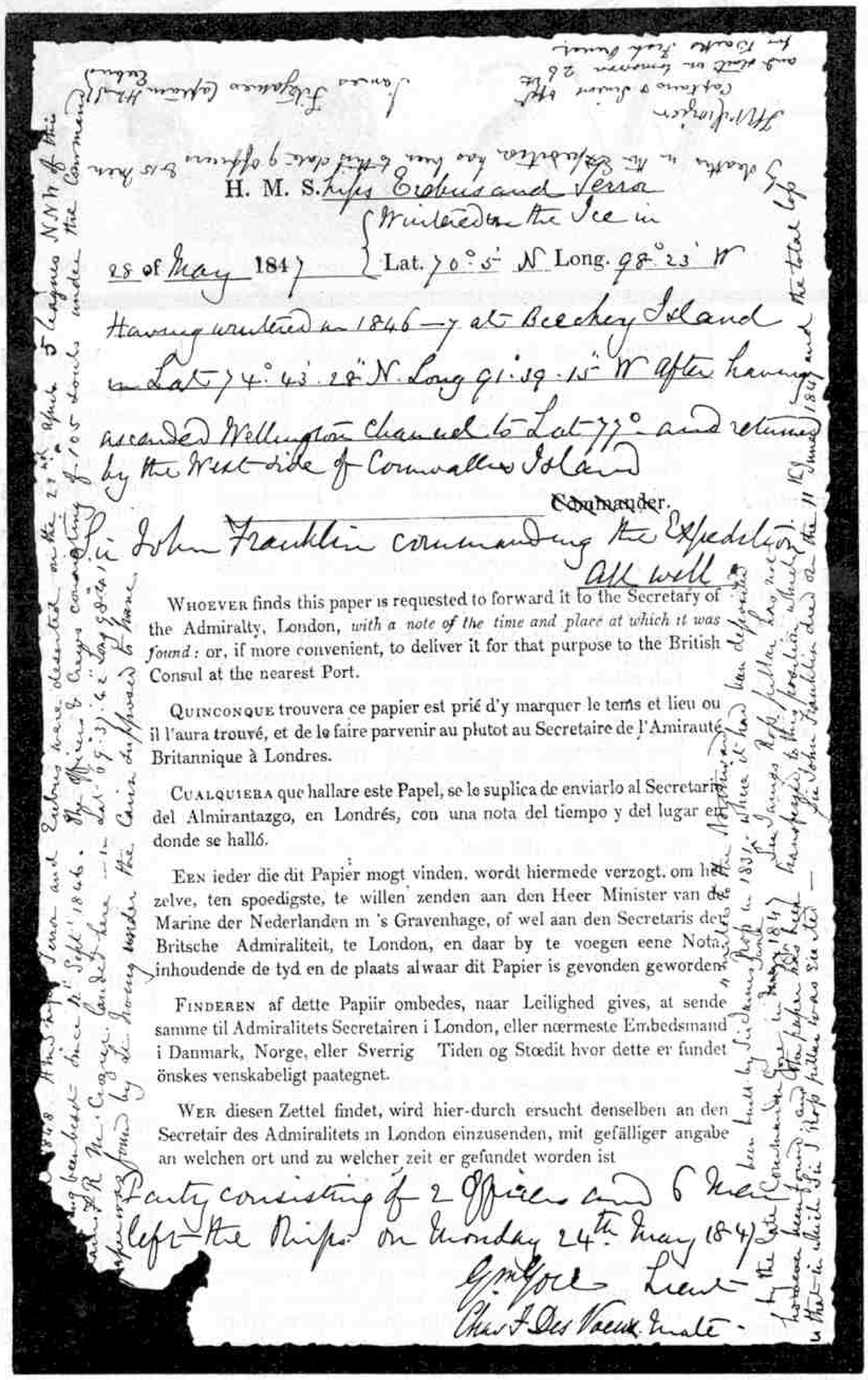
The return of the ship to the "Fox's Hole" was made without incident. Hobson had already returned. He

was suffering from scurvy and was unable to stand without assistance on his arrival. Soon afterward Captain Young also returned, M'Clintock meeting him at the western end of Bellot Strait. This third sledge journey had also been successful. Altogether Young had been away 78 days and had explored the whole of the coast of Prince of Wales Land then unknown. A feared shortage of provisions had led him to send four men back to the ship and for 40 days he had continued his journey with only one man and the dogs. The tent had been sent back with the party returning to the ship, so that it was necessary to build a snow hut each night. Later the weather became milder and the two explorers were able to sleep on the sledge, thus saving themselves two hours work daily.

Young was not content with this journey, and soon after his return to the ship he completed the exploration of the shores of Peel Sound without finding any traces of Franklin. Altogether he placed 380 miles of new coastline to the credit of the "*Fox*" expedition. Both Young and Hobson commented on the impracticable nature of the ice between Prince of Wales Land and Victoria Land. The former expressed his firm conviction that there was a continuous ice-stream from the north-west that constantly choked up the passage attempted by Franklin.

When the ice broke up, the "*Fox*" was worked out of its winter home and sailed for Greenland, after which came a quick and lively passage across the Atlantic.

The expedition had been one of the most successful on record. Not only had it secured the information it sought, but also valuable geographical discoveries had been made. The courage and skill displayed by M'Clintock won immediate recognition. A knighthood was conferred upon him and he was awarded a gold medal by the Royal Geographical Society. This was certainly no undeserved honour, for in the 12 years 1848-1859 he spent no fewer than 10 summers and six winters in the Arctic regions, and in 1853 he carried out the greatest Arctic effort that had ever been made. In this he was absent from the ship for 105 days, during which he must have walked 1,408 miles while discovering 768 miles of coastline.


H. M. S. Hrs Erebus and Terror
Wintered in the Ice in
Lat. 70° 5' N Long. 98° 23' W
28 of May 184
Having wintered in 1846—7 at Beechey Island
in Lat 74° 43' 28" N Long 91° 39' 15" W after having
ascended Wellington Channel to Lat 77° and returned
by the West side of Cornwallis Island
Commander.
Sir John Franklin commanding the Expedition.
All well
WHOEVER finds this paper is requested to forward it to the Secretary of the Admiralty, London, *with a note of the time and place at which it was found*: or, if more convenient, to deliver it for that purpose to the British Consul at the nearest Port.
QUINCONQUE trouvera ce papier est prié d'y marquer le tems et lieu ou il l'aura trouvé, et de le faire parvenir au plutot au Secretaire de l'Amirauté Britannique à Londres.
CUALQUIERA que hallare este Papel, se le suplica de enviarlo al Secretario del Almirantazgo, en Londrés, con una nota del tiempo y del lugar en donde se halló.
EEN ieder die dit Papier mogt vinden, wordt hiermede verzogt, om hetzelve, ten spoedigste, te willen zenden aan den Heer Minister van de Marine der Nederlanden in 's Gravenhage, of wel aan den Secretaris der Britsche Admiraliteit, te London, en daar by te voegen eene Nota, inhoudende de tyd en de plaats alwaar dit Papier is gevonden geworden.
FINDEREN af dette Papiir ombedes, naar Leilighed gives, at sende samme til Admiralitets Secretairen i London, eller nærmeste Embedsmand i Danmark, Norge, eller Sverrig Tiden og Stœdit hvor dette er fundet önskes venskabeligt paategnet.
WER diesen Zettel findet, wird hier-durch ersucht denselben an den Secretair des Admiralitets in London einzusenden, mit gefälliger angabe an welchen ort und zu welcher zeit er gefundet worden ist
Party consisting of 2 Officers and 6 Men
left the Ships on Monday 24th May 184
Lieut
Chas F. Des Voeux Mate.

The Franklin Record. A reproduction of the document giving the only first-hand account of the Franklin expedition

The courage and skill displayed by him while in command of the "*Fox*" finally established his fame as the foremost of Arctic explorers. He lived to celebrate the 50th anniversary of the sailing of the "*Fox*," and on that occasion the Council of the Royal Geographical Society addressed to him a congratulatory letter in which special mention was made of his conduct after the disheartening failure to reach Lancaster Sound in the first summer. This reference was as follows:—

> "There is nothing finer in our naval annals than your firmness and resolution when, after the misfortune of being beset for a winter, and then driven out of the ice in a gale of wind, you coolly turned the ship's head again "Northward Ho!" You sought no port for refreshment, but turned at once to the battle. Such indomitable pluck commanded success."

With the return of the "*Fox*" the Franklin search practically came to an end. For 10 long years attempts had been made either to rescue the possible survivors of the lost expedition or to find indications of their fate. Rae's journey in 1853 had made it practically certain that all had perished, while M'Clintock had gathered valuable information of Franklin's achievements but at the same time had confirmed the conclusions drawn from Rae's discoveries.

There still remained in the minds of a few a hope and belief that survivors would be found living with the Eskimos, and this led to a remarkable effort by C. F. Hall, an American explorer. He had lived for two years among the Eskimos of Baffin Land and the ease with which he had succeeded in adapting himself to their mode of life suggested to him that some of Franklin's men might have been equally successful. To put this belief to the test he landed on the western shore of Hudson Bay and made exhaustive inquiries (*Continued on page 70*)

Uses of Aircraft

According to statistics compiled by the United States Government, there are no fewer than 156 uses for aircraft—including bootlegging and other kinds of smuggling this total is raised to 159! Military and naval uses account for 32 of this number but the remainder are unconnected with Government forces.

Probably Canada presents the greatest range of uses for aircraft, and recently the Manitoba Agricultural Department have been feeding ducks from aeroplanes. It is not their intention, however, to make this a regular practice, but it is hoped that some proportion of the rice that has been dropped over the Moose Lake and Cedar Lake areas, the largest duck-breeding ground in North America, will escape the early attentions of the birds and form the nucleus of extensive wild rice fields that will provide food for future years.

In addition to the various patrol services which, in 1926 alone, located 227 forest fires in their early stages, the Royal Canadian Air Force has a section specially devoted to the detection of coastal smuggling and survey work. Private owners employ aeroplanes extensively for the transportation of stores and tools into the remoter areas. Air mail work also forms a large part of the aeroplane's task in Canada, and shortly several new services are to be undertaken.

The R.C.A.F. is to carry out some experimental work in the Gulf of St. Lawrence, the work being carried on well into the winter months, with the object of securing precise information on local flying conditions before contracts for mail carrying are placed with private companies. This preliminary work has one section that is paying special attention to a scheme for transferring mails from incoming steamers to the larger eastern centres. Another squadron is to be called upon to deliver mail to points in the north inaccessible by dog teams, where again a knowledge of actual working conditions will be useful in considering the establishment of regular mail routes.

It is an interesting fact that in spite of all this aerial activity, there is only one aircraft construction works in Canada, that of Messrs. Vickers at Montreal!

In other parts of the world aeroplanes are being put to similar civil uses. In the Alps near Mont Blanc, the French have applied aircraft to a job of road-making. A road to the Vallot Observatory, 14,312 ft. above sea level is being made, and cement, tools and workmen are being conveyed to and from the site of operations by aeroplane. Out in the North Pacific, aeroplanes are co-operating with whaling steamers in locating their prey. In the White Sea, seals are spotted from the air and off the Californian coast, aero-anglers are indulging in excellent sport, trolling for tunny and swordfish from low-flying machines. In Russia, the advance of a locust plague was stopped by poison gas; Alsace-Lorraine eliminated a caterpillar plague with poison also, while the swampy regions of Louisana, almost uninhabitable through the attentions of malaria carrying insects, have been made tolerable by spraying the swamps with calcium-arsenate powder.

In Formosa, the Japanese Government has subdued a formidable tribe of head hunters, who made a speciality of attacking lumbermen in the jungles. The Formosan tribes are extremely superstitious and have great faith in the stories of monstrous bird-like creatures that figure so prominently in their mythology. An astute official of the Japanese Governor's staff first spread a story that the gods were incensed by the callous murders carried out by the head hunters, and they proposed to send these bird-like dragons to punish the tribes. Once the story had gained currency, two large aeroplanes were sent over the tribesmen's territory and dropped a number of bombs. The impact of these extraordinary "eggs," for such they were believed to be, caused widespread fear, and there has been no more trouble in that area.

Of survey work we have written much in the past and the various branches of this work are known to all our readers. One new use of survey work, however, has come to our knowledge in a report from Northern Rhodesia, where an expedition is now making photographs of an area of 62,000 sq. miles along the Rhodesian-Congo border. The photographs are expected to reveal tracts of stunted vegetation that will disclose the location of large deposits of copper ore, known to be present in the locality.

* * * *

Aviation Activity in Canada

The Canadian Government have ordered 26 new aeroplanes and attendant equipment at a total cost of £80,000. This is part of a programme for increasing the establishment of the Canadian Air Force, and side by side with this programme, civil aviation is receiving every encouragement. The Government have undertaken to give two aeroplanes to each city that forms a flying club, provided that the clubs themselves will undertake the maintenance of the machines.

Improved Aerial Survey Methods

The highly specialised requirements of aeroplanes employed on survey work, particularly in uncharted tropical areas, have led the Aircraft Operating Company to prepare special designs for a survey machine. The company now have many expeditions working over Rhodesia and the upper waters of the Zambesi, and so successful has been the early work of the Rhodesian party that new inquiries point to the eventual establishment of a permanent survey expedition in Africa.

The principal point to be considered in designing the machine was the elimination, as far as was humanly possible, of the risk of forced landings. A twin-engined machine with a range of 300 miles, and with sufficient power to "get home" on one engine only, is projected. The range is sufficient to enable the machine to survey an area of 60,000 sq. miles from one base, this area being considered to be the minimum at which full economy of working can be secured. Costs for an area of this size lie between £3 and £4 per sq. mile, but as the area decreases so the rates per mile increase.

One of the chief difficulties hitherto experienced in securing good survey photographs of tropical areas has been the absence of a photographic film of sufficient speed to use with the light filters that have to be employed to cut out haze. A British firm has now succeeded in producing a satisfactory emulsion from which films of the necessary high speed may be prepared. These films are used in conjunction with an electrically operated automatic camera known commercially as the "Eagle"—a development of the well-known Air Ministry F8 camera.

* * * *

Supermarine-Southamptons for Australia

The trials of the two Supermarine-Southampton flying boats that have been built for the Royal Australian Air Force have now been completed successfully, and the machines have been dismantled and packed for despatch to Australia. Each machine is fitted with two 450 h.p. Napier "Lion" engines, and will be used by the R.A.A.F. first for a flight from Australia to Singapore and back. During the course of this flight the machines will link up with the Royal Air Force Far East flight now in progress, and which is due to reach Singapore at approximately the same time as the Australian machines. The machines are identical with the standard R.A.F. Southampton, with the single exception that instead of an all-metal hull they have the standard wooden hull.

Sir Alan Cobham's New African Flight

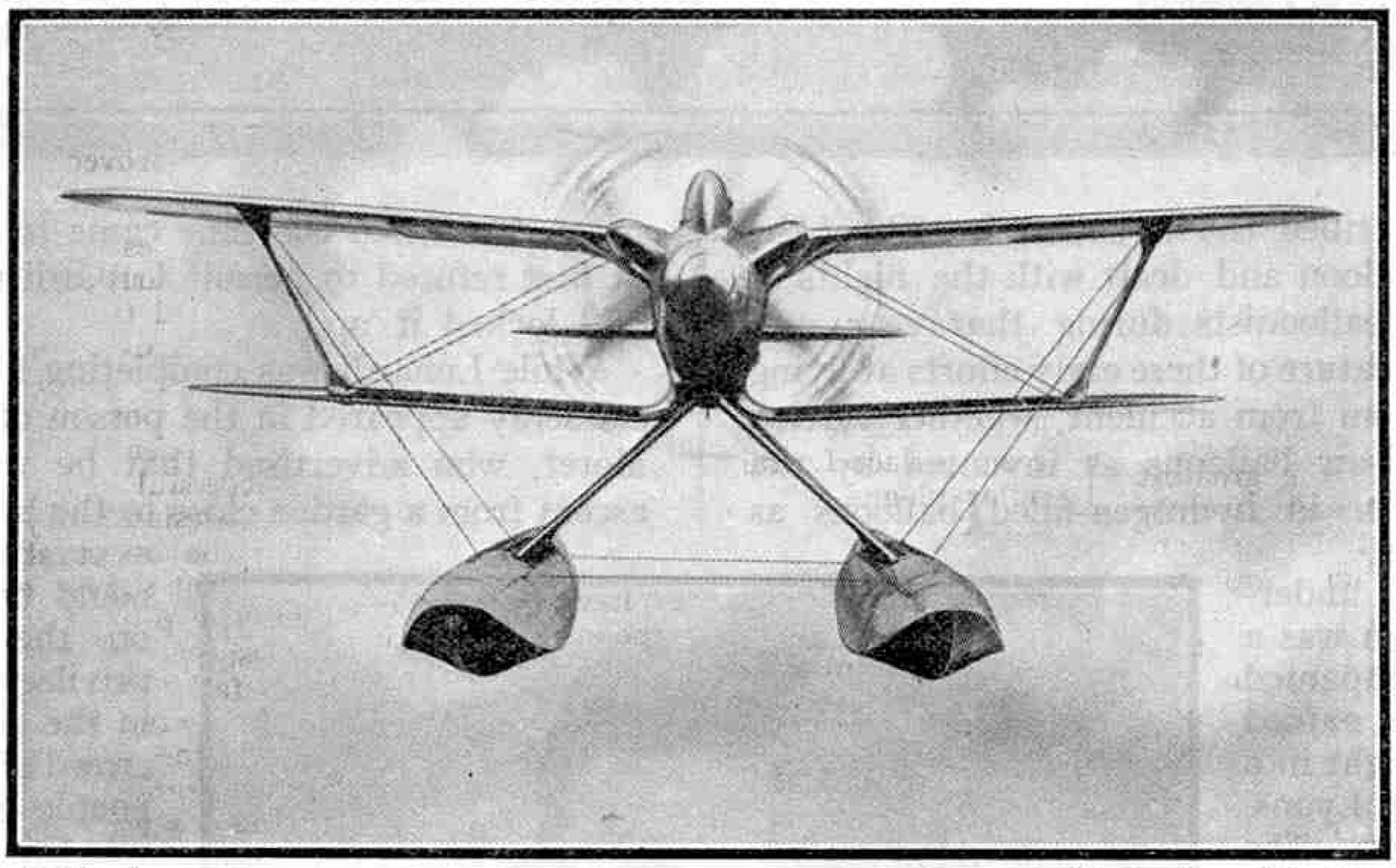
Sir Alan Cobham is now engaged on yet another Empire flight. In the middle of November he left London in a Short Singapore all-metal flying boat, fitted with two Rolls-Royce "Condor" engines, on a surveying flight around Africa. The objects of the expedition are to survey certain sections of the route through Africa and to investigate flying conditions with an eye to the commercial possibilities of air lines through the centre of Africa and along the West coast. Frequent stops are to be made en route to meet representatives of the Governments of the territories over which the routes would pass, and large commercial organisations in the areas covered are to be canvassed with a view to securing support for any projects that may be brought forward as a result of Sir Alan's report. The number of these interviews involved is such that no definite timetable for the present flight has been laid down. In fact, Sir Alan has intimated his willingness to go "up country" anywhere in Africa to discuss civil air transport or aerial survey, as applied to any particular district.

The outward route lay by way of Bordeaux, Marseilles, Ajaccio, across the Mediterranean, via Malta to Bengazi, then along the North African coast to Aboukir, and by way of the River Nile to Khartum. From there the route of the Khartum-Kisumu service, concerning which we have published several notes, will be followed. From Kisumu the machine will pass south along the Great Lakes, Victoria, Tanganyika, and Nyassa, and thence over Portuguese East Africa via the Zambesi River to the coast at Beira. From Beira the route continues completely round the south-east, south and west coasts of Africa until the Straits of Gibraltar are reached. Then the machine will cross the Mediterranean to Marseilles, fly across France to Bordeaux and up the French coast to the English Channel, Plymouth and home.

The section of the flight up the west coast of Africa is of special interest, as probably it will be the first occasion that any British aeroplane, certainly a flying boat, has been seen. North of Dakar an aeroplane is nothing new, for French services cover this ground with comparative frequency.

As we go to press we learn that Sir Alan is still held up at Malta awaiting the repair of his machine. On the outward flight, after a safe landing at Malta, a gale sprang up and carried the machine's wing floats away.

In Full Flight



Courtesy] [Gloster Aircraft Co. Ltd.

The Gloster-Napier IV Schneider Cup machine in flight. The wing span in this machine is only 22 ft. 6 ins., and it shows an amazingly small area of head resistance, as will be seen from the illustration (see also page 44)

New U.S. Aircraft Carrier

A sister ship to the U.S. aircraft carrier "*Lexington*" has recently been completed and has undergone trials. This vessel, which has been named the "*Saratoga*," has been under construction for nearly seven years, her keel having been laid in January 1921. Originally it was intended that the "*Saratoga*" should be a battle cruiser with a displacement of 43,500 tons and a main armament of eight 16-in. guns. Some idea of the size of this proposed cruiser may be gained from the fact that her displacement would have been 2,300 tons greater than that of the British battle cruiser "*Hood*," which is the largest capital ship in the world.

As the outcome of the Washington Conference, which limited the displacement of battleships and cruisers to 35,000 tons, the "*Lexington*" and the "*Saratoga*" were re-designed as aircraft carriers, their displacement being reduced to 33,000 tons. The "*Saratoga's*" original machinery has been retained and she is expected to attain a speed of 34·5 knots. The flight deck is 880 ft. in length with a width of 90 ft. and provides hangar accommodation for 72 aircraft, among which will be 31 bombing machines.

The principal armament consists of eight 8-in. guns mounted in twin turrets, twelve 5-in. anti-aircraft guns and four torpedo tubes. The single funnel, the bridges, mast and gun turrets, all are placed well over on the starboard side of the ship leaving the flight deck almost entirely un-obstructed.

* * * *

The South African Government have now selected the site of the mooring mast to be used for the airships flying over the proposed Empire Air Routes. This is to be located at Tongaat, 30 miles from Durban, where a large aerodrome is in course of construction.

London-New York in Three Hours!

A correspondent in the "*Daily Mail*" recently suggested that the growing demand for speed in modern life would eventually find the aeroplane wanting. This idea seems very extraordinary in view of the fact that, in spite of the infancy of aviation as a science, machines have been produced that can travel at over 300 m.p.h. It might be thought that at this speed the limit of human endurance had been reached but apparently this is not the view of leading aviation experts, as is shown by Mr. Harry Harper's reply to the correspondent mentioned. In a letter to the "*Daily Mail*" Mr. Harper says:—

"Not only engines, but also propellers, are now being designed specially for high-altitude conditions, and the results obtained are already so significant that Mr. A. V. Roe, one of our greatest British pioneers, has wagered that in 25 years' time passengers in luxurious enclosed saloons, in which the air is maintained in just as 'breathable' a condition as at earth level, will be flying across the Atlantic 10 miles high, and at a speed as great as 1,000 miles an hour."

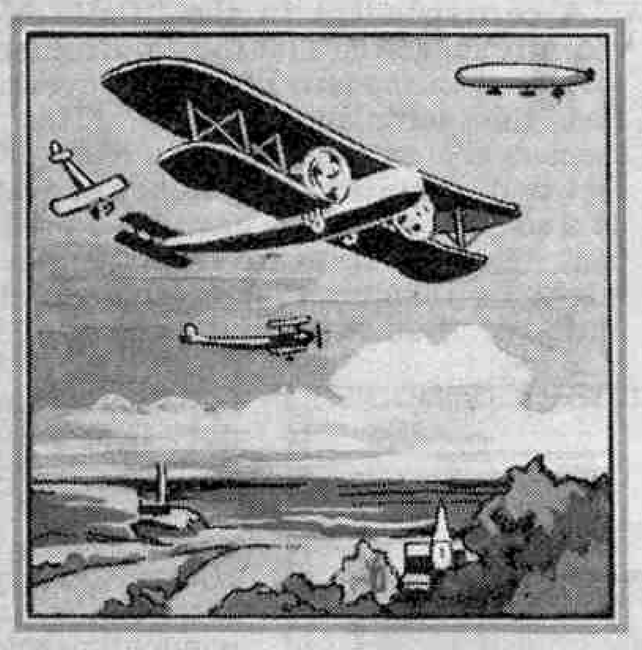
* * * *

Airships for Empire Routes

The first of the two 5,000,000 cu. ft. airships now being built for use on the inter-Empire air routes will be completed within the next few months, according to a statement made recently by Sir Philip Sassoon, Under-Secretary for Air. Photographs of one of these huge ships in course of construction were published recently and they resemble nothing so much as a huge Meccano model!

The maiden flight of the first of these ships will be across the Atlantic to Canada and back. This announcement comes as a surprise, for hitherto it has been understood that the first flight of the commercial ships would be to India, via the Cairo-Karachi air route. An airship mooring tower is to be erected in Canada on the southern side of the River St. Lawrence and a site for this already has been chosen.

There must be some special reason for this new departure, and it would appear that a propaganda flight is projected. The Zeppelin Company are building an airship that is intended to operate a monthly service between Seville, Spain, and the Argentine. Presumably official circles consider it desirable that the capabilities of the British airships over the trans-Atlantic route should be demonstrated as early as possible.



The Conquest of the Air

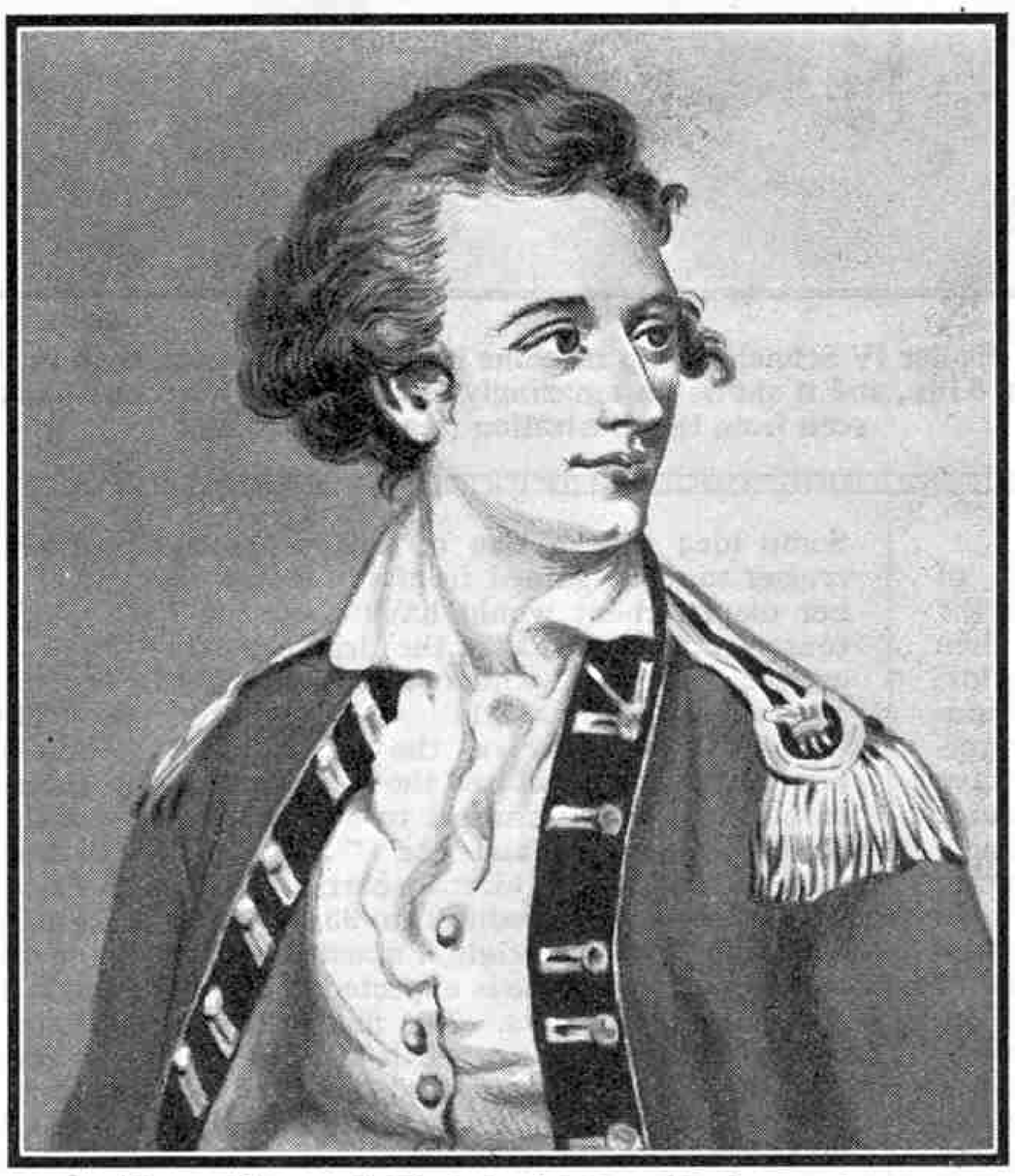
EARLY BALLOON ASCENTS

LAST month we described the invention in 1783 of the first practical balloon and dealt with the flights of various pioneer balloonists during that year and 1784. A remarkable feature of these early efforts at flying was their entire freedom from accident, whether carried out by means of hot-air balloons as invented by the Montgolfier brothers or in hydrogen-filled balloons as devised by M. Charles.

The first woman to undertake a flight by balloon was a Mme. Thible, who accompanied a French aeronaut named Fleurand on a short flight in a Montgolfier balloon at Lyons, on 4th June, 1784. The balloon, which was 70 ft. in diameter, rose to a height of roughly 8,500 ft. and drifted two miles before descending to earth 45 minutes later. This ascent was witnessed by the French Court, with whom was King Gustavus of Sweden.

As related last month, the first balloon passenger flight in Great Britain was achieved by a Mr. Tytler who, on 27th August, 1784, ascended in a Montgolfier balloon from the Comely Gardens, Edinburgh. At the time when this event took place in Scotland, Vincent Lunardi, a native of Italy and secretary to the Neapolitan Ambassador in London, was preparing to carry out a balloon flight and early in July he applied to the Governor of Chelsea Military Hospital for permission to make an ascent from Chelsea Gardens. He undertook that only those who paid for admission would be allowed within the Gardens to witness at close quarters his ascent, and that all money thus paid would be presented to the hospital. His request was granted, and on the scheme becoming known the King readily gave his patronage.

When the balloon was completed it was placed on exhibition in a large room at the Lyceum, London, where more than 20,000 people paid for admission to view it. This scheme proved so profitable to the proprietor of the room that when the time came to end the exhibition he at first refused to permit Lunardi to remove the balloon and locked it up!



Vincent Lunardi, First Aerial Traveller in England

While Lunardi was completing his preparations a rival suddenly appeared in the person of a Frenchman named Moret, who advertised that he would make a balloon ascent from a garden close to the hospital on 11th August —several days before Lunardi could be ready. Accordingly on the 11th a number of privileged persons waited within the garden, while outside a crowd of from 50,000 to 60,000 people gathered. The ascent was timed to take place about 1 p.m., but after three hours of vain efforts to fill the envelope the balloon suddenly collapsed.

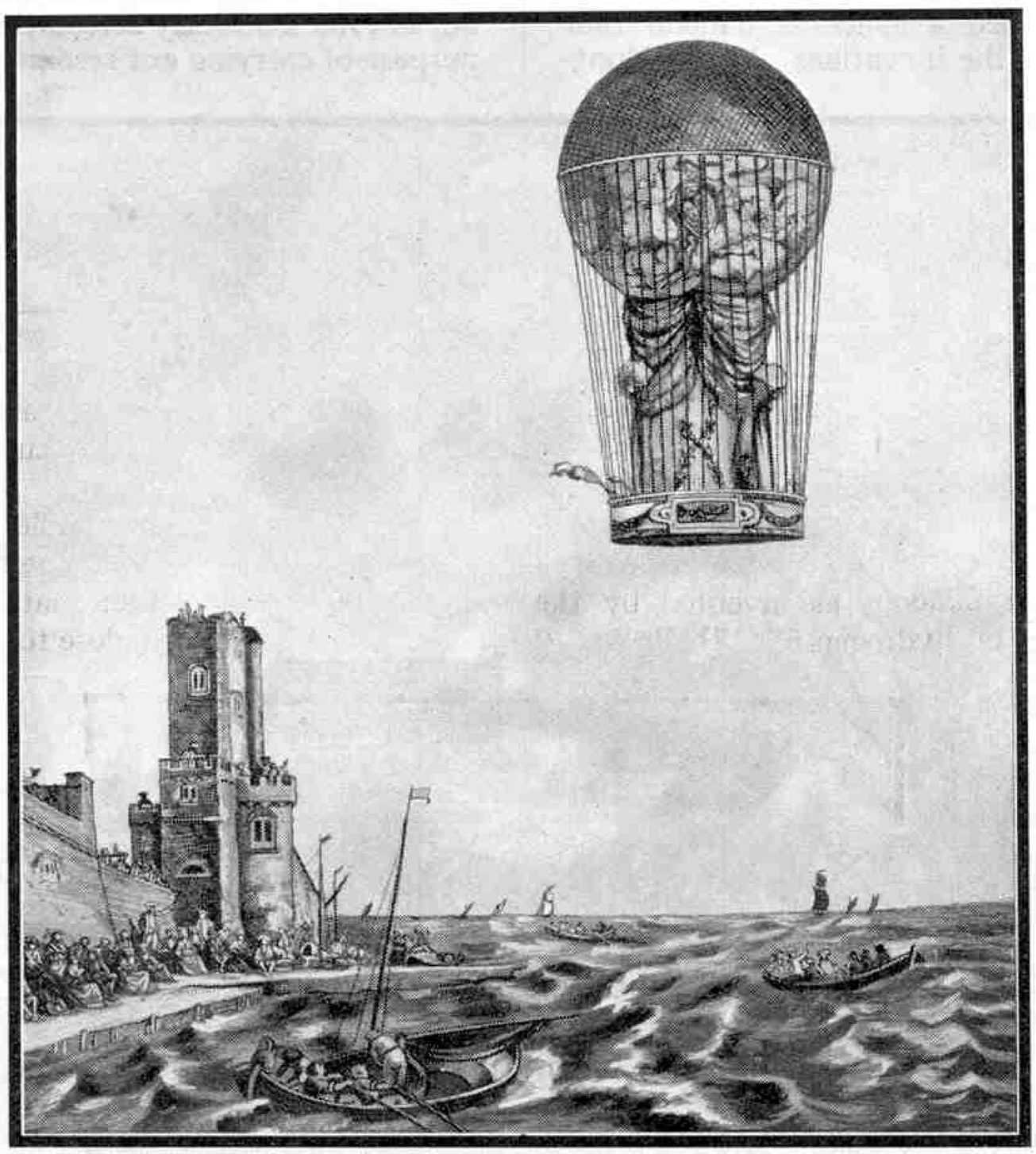
The crowd had long since lost patience with the unfortunate promoters and now became convinced that Moret was an impostor. Yelling madly, they scaled and broke down the garden fencing, tore the balloon to pieces, robbed many of the distinguished company gathered within the garden, and generally spread terror and desolation throughout the district. Moret fled for his life and succeeded in evading the enraged mob.

As a result of this unpleasant episode the hospital authorities withdrew the permission granted to Lunardi, but the Honourable Artillery Company came to his rescue and offered him the use of their training ground for his experiment. Accordingly the balloon and filling apparatus were removed there from the Lyceum and everything was made ready for an ascent on 15th September. The Moret fiasco was still fresh in the mind of the public, and the 150,000 people who on that day crowded the windows and roofs of houses adjoining the Artillery Ground and utilised every other available vantage point included many who intended to wreak vengeance upon Lunardi in the event of his failing to carry out his programme.

Unfortunately the filling of the balloon did not proceed at all satisfactorily, and when the ascent was almost an hour overdue the crowd began to show signs of impatience. Lunardi became apprehensive and at last decided to cease inflating the envelope and to make an ascent with such gas as had been injected. Filling was therefore stopped, and a few minutes later Lunardi, accompanied by a friend named Biggin, climbed into the car. The load proved more than the partially filled balloon could lift, however, and it was decided that Lunardi only should ascend. A smaller and lighter car was hastily substituted for the original one, and the aeronaut once more took his place.

By this time the crowd were shouting uncomplimentary things to Lunardi and his assistants, but the situation was saved when a gun was fired to announce that the ascent was about to take place. The retaining ropes were severed and the balloon soared above the vast throng of people, who immediately took off their hats and cheered wildly.

The balloon was made of oiled silk, painted blue and red, and was 33 ft. in diameter. The upper two-thirds were covered with netting, from which 45 cords led down to a hoop below the envelope to which the car was attached. The balloon had no valve, but its neck terminated in the form of a pear, at the lower and narrow extremity of which was an aperture through which the hydrogen had been introduced and could be let out. As shown in the accompanying illustration, the balloon was equipped with blades or oars to enable it to be steered during the absence of wind, but these proved of little use.



Balloon constructed by de Rozier to make the first channel crossing, in which he was anticipated by Blanchard

In a letter to the Neapolitan Ambassador, Lunardi described his experience as follows :—

"As a multitude lay before me of a hundred and fifty thousand people who had not seen my ascent from the ground, I had to recourse to every stratagem to let them know I was in the gallery, and they literally rent the air with their acclamations and applause. In these stratagems I devoted my flag and worked with my oars, one of which was immediately broken, and fell from me. A pigeon, too, escaped, which, with a dog and a cat, were the only companions of my excursions. When the thermometer had fallen from 68° to 61° I perceived a great difference in the temperature of the air. I became very cold, and found it necessary to take a few glasses of wine. I likewise ate the leg of a chicken ; but my bread and other provisions had been rendered useless, by being mixed with the sand which I carried as ballast.

"The King was in conference with his principal Ministers. On being informed that I was passing, the King said : 'We may resume our deliberations on the subject before us at leisure ; but we may never see poor Lunardi again.' The conference broke up, and his Majesty, attended by Mr. Pitt and other great officers of State, viewed me through telescopes while I remained in their horizon."

Lunardi descended in a cornfield at South Mimms, Hertfordshire, to land the cat, which was suffering considerably from the cold. The balloon then reascended rapidly and the thermometer ultimately registered 29°. Safe descent was made 50 minutes later in a meadow at Standon, near Ware.

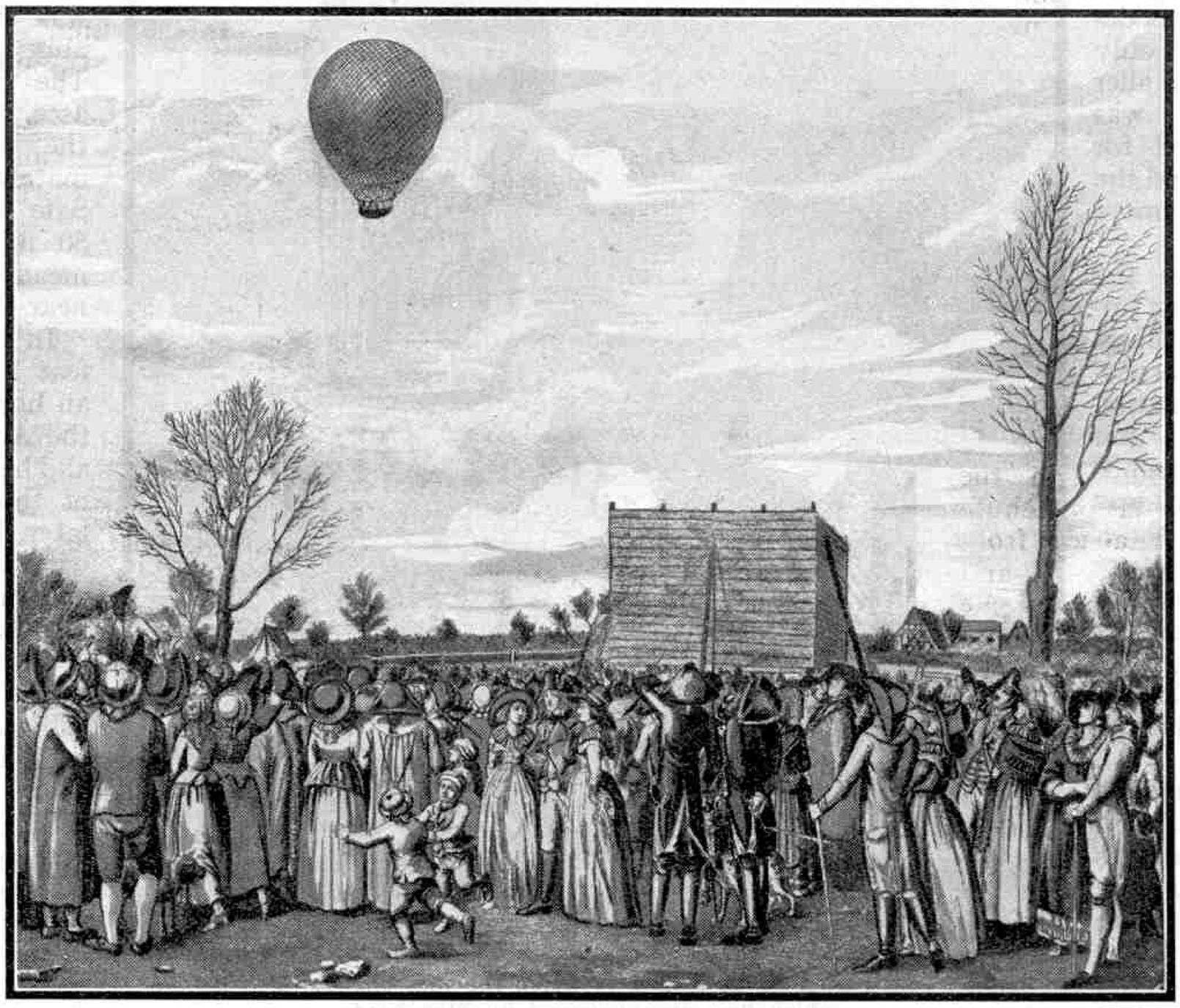
In recognition of his feat Lunardi was made an honorary member of the Artillery Company, and he wore the uniform of this regiment when later he had audience with the King, who congratulated him on his successful flight.

The first passenger flight across the English Channel was accomplished by Blanchard on 7th January, 1785, and created a great sensation in France where the science of aerostatics, as the art of ballooning was called, was being assiduously developed. Blanchard ascended from the cliffs at Dover, taking with him an American named Dr. Jeffries, who had previously accompanied him during an experimental trip over Kent, on which occasion it had been found that the balloon would barely carry a load of two passengers. The Channel flight had been in progress only a very short time when the balloon began to descend rapidly and ballast had to be thrown out. By the time the French coast was sighted, not only had all the sand ballast been cast overboard, but anchors, cords, books, provisions and even clothing had been thrown out to lighten the balloon. As a last resort the aeronauts fastened themselves to the ropework above the car, intending to cut away the latter, but just as they were about to do this the balloon approached the Forest of Guines and descended so low that Dr. Jeffries succeeded in grasping the branch of a tree and thus stopping the balloon. The valve was then opened and the envelope deflated. The descent was observed by some horsemen crossing open country, and they arrived on the scene about half an hour later.

On the following day Blanchard was feted at Calais, where a magnificent banquet was held in his honour and the freedom of the city was conferred upon him. The balloon in which he had made the crossing was purchased subsequently by private subscription and

placed in the church of Calais as a memorial of the flight.

When Pilâtre de Rozier, whose pioneer flight was described last month, heard of Blanchard's success he at once resolved to accomplish the same feat, but from France to England. In order to be able to decrease or increase the weight of his balloon at will and thus obviate an extravagant discharge of ballast such as Blanchard had to make, de Rozier constructed a spherical balloon that embodied the principles of the inventions of both Montgolfier and Charles. His balloon consisted of a hydrogen-filled silk envelope, to the bottom of which he affixed a cylindrical receiver that could be filled with air heated by a fire contained in a small grate beneath it. When the design of this balloon became known it was severely criticised by scientists and by other aeronauts, who declared that nothing would prevent the hydrogen from catching fire. Large sums of money were lent to de Rozier, nevertheless, to enable him to build his balloon and to defray the various other expenses associated with the project.



Blanchard's 28th balloon ascent at Nuremberg in 1787

The balloon and the filling apparatus were conveyed to a site near Boulogne to await a day of favourable wind. Week succeeded week without the arrival of suitable weather conditions, however, and de Rozier began to lose heart. The strain told upon him severely, and it is fairly certain that but for threats of legal action by some of his creditors he would have abandoned the scheme entirely.

Gradually the weather conditions improved and on 16th June, 1785, a light easterly breeze was blowing and de Rozier decided to make the trip. It is said that a strange premonition of coming disaster haunted him as he climbed into the car of his balloon along with a friend named Romaine. After a final handshake de Rozier gave the signal for the retaining ropes to be released and the balloon shot up into the air. After drifting some distance seaward it became stationary and remained so for a short time, after which it began to drift slowly landward again. Then to the horror of the watchers below the balloon suddenly collapsed and crashed to earth with terrible velocity, coming down close to the place where Blanchard had descended after his successful crossing. Witnesses of the disaster rushed to the rescue, but on reaching the wreckage they found de Rozier already dead and Romaine survived only for a short time.

Thus occurred the first fatal accident in the history of ballooning. The catastrophe cast a great gloom over France and resulted in a public outcry against such attempts to excel the achievements of earlier pioneers.

The advent of the French Revolutionary wars thrust the subject of ballooning temporarily into the background, but in 1793 a military aerostatic corps was formed for the purpose of carrying out reconnaissance work by means of balloons. A training school was established at Meudon under the supervision of Colonel Coutelle, and 50 young military students were admitted. Considerable importance was attached to this new phase of military training and great precautions were taken to keep secret the activities of the school. A hydrogen balloon 32 ft. in diameter was employed, and was kept constantly full so as to be always available. When in use the balloon was allowed to ascend to a height of 500 ft. or 600 ft., and was then restrained by a stout cord that extended down to a strong windlass on the ground, by the operation of which the balloon was drawn down again later.

When the school was well established Coutelle was commissioned to carry out reconnaissance work with the Northern Army, in June 1794. On the day preceding the battle of Fleurus two ascents were made in an observation balloon, in order to discover the activities of the opposing Austrian forces. Coutelle was accompanied by two other officers, and on each ascent the party remained up about four hours. The second ascent was somewhat exciting, as the balloon had not ascended very high when it was discovered by the enemy, who at once opened fire. Writing later of the incident Coutelle said :—

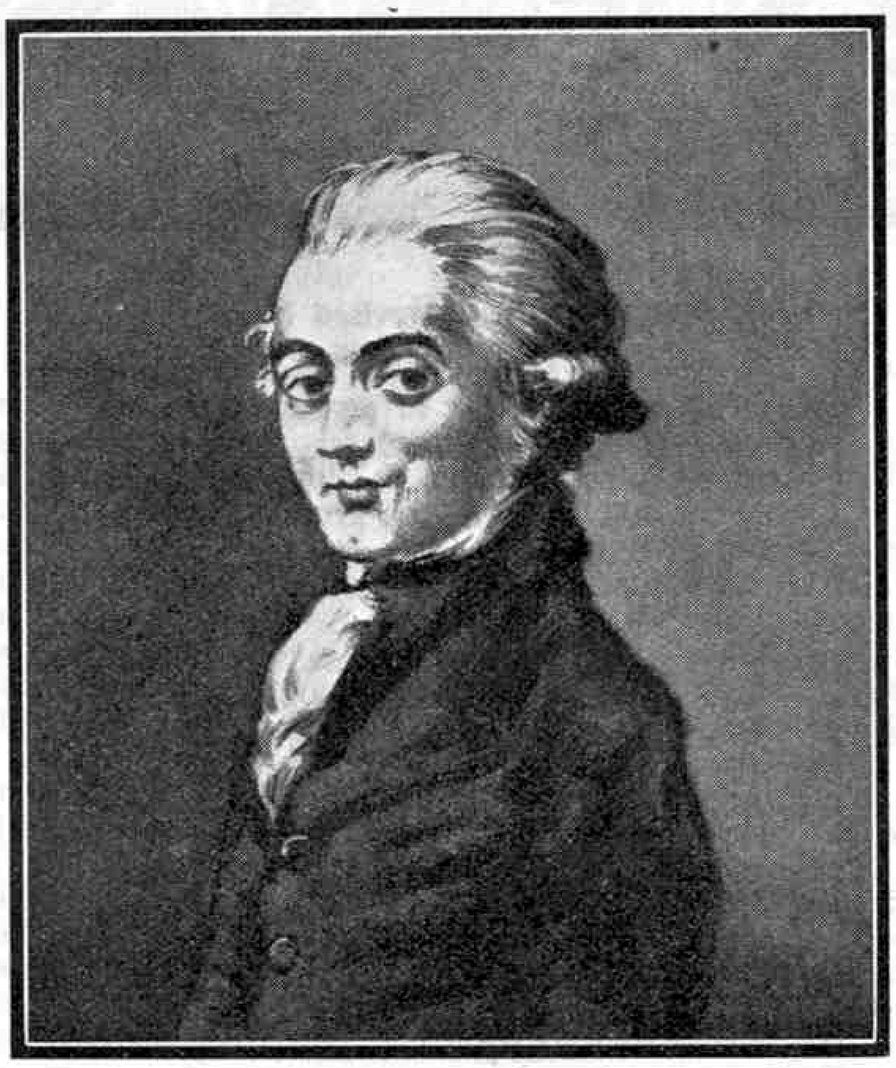
"A 17-pounder, masked in a ravine within easy distance, fired at the balloon as soon as it rose above the ramparts. The ball passed over our heads, the second was so near I thought the aerostat was perforated, and the third fell below us. When I gave the signal to haul down, my company did it with such vigour that only two more shots could be fired ; next morning the piece was no longer in position."

Messages to the French troops below were conveyed by means of signals attached to the sides of the balloon car,

and instructions from the troops to the aeronauts were given by signals stretched on the ground.

The death of de Rozier and Romaine had brought home to inventors of balloons the need of some device whereby an aeronaut could free himself from an uncontrollable balloon and descend safely to earth. Two years previously an inventor named Le Normand had devised a parachute for use as a fire-escape and had demonstrated its practicability by safely letting himself down by means of it from the windows of a high building in Lyons. Blanchard saw in the parachute a possible solution to the problem of making a safe descent from a balloon wrecked in mid-air, and he constructed a silk parachute with which he carried out a number of successful trials, using dogs and other animals as passengers.

The parachute and the animal were taken up when Blanchard made a balloon ascent. When a moderate height had been attained the animal was placed in the basket of the folded parachute which was then detached from the side of the balloon car and allowed to drop to earth. As the parachute fell the atmosphere exerted an upward pressure that caused it to open like an umbrella thus presenting to the atmosphere increasing surface area. In this manner the velocity of the descent was so decreased that when the earth was reached the animal passenger was deposited gently and unharmed. The success of these experiments decided Blanchard to attempt a descent himself. He did this in 1793 on the occasion of a balloon ascent at Basle, but unfortunately on this occasion the parachute failed to work properly and Blanchard received a broken leg in the subsequent fall.



Jean Pierre Blanchard

In the same year another Frenchman named Garnerin, was sent by the Revolutionary authorities as a special commissioner to the Northern Army. Shortly afterward he had the misfortune to be among the prisoners taken by the Austrians after the fierce battle of Marchiennes, and for 2½ years he was confined in a fortress at Bude, Hungary. During that time he devoted considerable study to the problem of parachutes, and when he was once more a free man one of his first occupations was the construction of a parachute according to his ideas.

Garnerin's Parachute

Garnerin's first demonstration in France of his parachute was carried out on 22nd October, 1797, and was witnessed by a crowd of several thousand people. One account of the event says: "The citizen Garnerin rose from the Park of Monceau, a solemn silence pervaded the multitude; excitement and uneasiness was depicted in every countenance. When he had reached an altitude of more than 6,000 ft. he cut the cord that attached him to the aerostat, which ascended until it exploded, whilst the parachute with the citizen Garnerin descended rapidly. The oscillations it underwent drew forth a cry from the spectators, and many women fainted. However, the citizen Garnerin descended on the plain of Monceau."

Garnerin was thus the first aeronaut to accomplish without mishap a descent from a balloon by means of a parachute. In the summer of 1802 he visited this country and successfully carried out several aerial voyages and parachute descents.

In 1803 Count Zambeccari, who was the first to send up a hot-air balloon in England, participated in a remarkable balloon night voyage from Bologna in Italy. The ascent should have taken place during daylight and a large crowd of people had gathered to witness the event. Sundry hindrances so delayed the filling of the balloon envelope, however, that when darkness came on the task was still incomplete. A proposal to defer the ascent until the following morning was rejected by the crowd, who began to be unpleasant. Zambeccari, perhaps not unmindful of the experience of Moret and Lunardi, decided to ascend that night, and filling was therefore continued.

At midnight all was ready for the ascent. The Count, accompanied by Dr. Grasetti of Rome and Sr. Andreoli of Ancona, boarded the car, taking with them a lighted lantern with which to discern the readings of the various instruments. On being released the balloon rose slowly and hovered above the town for a considerable time before a south-westerly wind carried it away on a swift and definite course.

"I intended to remain at the same level until it was light," related Zambeccari afterwards, "but I soon perceived a tendency to fall. I still hoped to descend without danger near Bologna, when all of a sudden we rose with inconceivable rapidity, and the lamp it was intended should be seen from the earth was extinguished; the feeble light of a lantern, however, still allowed us to look at the barometer. The insupportable cold, together with no food for twenty-four hours, caused me to fall into a sleep resembling death; Grasetti was affected in the same way; Andreoli only remained awake. . . . .

"We descended slowly through thick clouds and when we were below them Andreoli heard the rolling of waves. He told me this with alarm, and soon my own ears confirmed the truth. I instantly seized a bag of ballast, but before I could throw it out the

(Continued on page 72)

L.M.S. Named Trains

Several more L.M.S. expresses have been named. These are as follows :—

"*The Mid-day Scot.*" 1-30 p.m. London (Euston) to Glasgow (Central) and Edinburgh (Princes Street). 1-30 p.m. Glasgow (Central) and Edinburgh (Princes St). to London (Euston). (Restaurant Cars).

"*The Night Scot.*" 11-45 p.m. London (Euston) to Glasgow (Central) and Edinburgh (Princes Street). 10-30 p.m. Glasgow (Central) to London (Euston). (Sleeping Cars).

"*The Royal Highlander.*" 7-30 p.m. London (Euston) to Inverness. (Sleeping Cars).

"*The Thames-Clyde Express.*" 11-45 a.m. London (St. Pancras) to Glasgow (St. Enoch). 9-15 a.m. Glasgow (St. Enoch) to London (St. Pancras). (Restaurant Cars).

"*The Thames-Forth Express.*" 9-0 a.m. London (St. Pancras) to Edinburgh (Waverley). 10-5 a.m. Edinburgh (Waverley) to London (St. Pancras). (Restaurant Cars).

"*The Irish Mail.*" 8-30 a.m. and 8-45 p.m. London (Euston) to Holyhead. 12-13 a.m. and 12-18 p.m. Holyhead to London (Euston). Restaurant cars on day service and sleeping cars on night service.

"*The Sunny South Express.*" 10-30 a.m. Liverpool (Lime Street) and 10-40 a.m. Manchester (London Road) to Brighton, Eastbourne and Ramsgate, and corresponding return. (Restaurant Cars). Runs southbound on Saturdays only, and northbound on Mondays only, through the winter months.

"*The Pines Express.*" 10 a.m. Manchester (London Road) and 9-40 a.m. Liverpool (Lime St.) to Bournemouth (West).

10-20 a.m. Bournemouth (West) to Manchester (London Road) and Liverpool (Lime Street). Through carriage Liverpool to Southampton and vice versa. (Restaurant Cars).

"*The Devonian.*" 10-12 a.m. Bradford (Forster Square) to West of England and 12-55 p.m. Bristol (Temple Meads) to Bradford (Forster Square). (Restaurant Cars).

"*The Yorkshireman.*" 9-10 a.m. Bradford (Exchange) to London (St. Pancras) and 4-55 p.m. London (St. Pancras) to Bradford (Exchange). (Both Saturdays excepted). (Restaurant Cars).

"*The Mancunian.*" 9-45 a.m. Manchester (London Road) to London (Euston). 6-5 p.m. London (Euston) to Manchester (London Road). (Restaurant Cars).

"*The London-Merseyside Express.*" 9-45 a.m. Liverpool (Lime Street) to London (Euston). 5-55 p.m. London (Euston) to Liverpool (Lime Street). (Restaurant Cars). G.F.F.

G.W.R. Castles—Revised Naming

In our November, 1925, issue we published a complete list of projected engines of the G.W.R. Castle class. For special reasons it was decided to alter the names allotted to certain of the group numbered from 5000–12. All these engines now are on the road, the revised names being as follows :—

5000—"*Launceston Castle*"; 5001—"*Llandovery Castle*"; 5002—"*Ludlow Castle*"; 5003—"*Lulworth Castle*"; 5004—"*Llanstephan Castle*"; 5005—"*Manorbier Castle*"; 5006—"*Tregenna Castle*"; 5007—"*Rougemont Castle*"; 5008—"*Raglan Castle*"; 5009—"*Shrewsbury Castle*"; 5010—"*Restormel Castle*"; 5011—"*Tintagel Castle*"; 5012—"*Berry Pomeroy Castle.*"

Ten entirely new "Pacific" engines of the high-pressure design are now under construction at Doncaster.

The following table gives the comparative dimensions of the 180 lb. and 220 lb. "Pacific" engines, the first figure in each case being that of the original 180 lb. pressure engines :—

Boiler Pressure ...	180 lb. ...	220 lb.
Tubes—Number ...	168 ...	125
Outside Diameter	2¼ in. ...	2¼ in.
Flues—Number ...	32 ...	43
Outside Diameter	5¼ in. ...	5¼ in.
Heating Surface—		
Fire-box	215 sq. ft. ...	215 sq. ft.
Tubes	1,880 ,, ...	1,398.8 ,,
Flues	835 ,, ...	1,122.8 ,,
Total evaporative H.S.	2,930 ,, ...	2,736.6 ,,
Superheater—		
Number of elements	32	43
Heating surface ...	525 sq. ft. ...	607 sq. ft.
Total heating surface	3,455 ,, ...	3,343.6 ,,
Grate area ...	41.25 ,, ...	41.25 ,,
Cylinders (three) ...	20 in. dia. by 26 in. stroke	20 in. dia. by 26 in. stroke
Tractive effort at 85 per cent. boiler pressure	29,835 lb. ...	36,465 lb.
Total adhesive weight	134,400 lb. ...	148,176 lb.
Adhesive weight—		
Tractive effort ...	4.5 ...	4.06
Weight of engine in W.O. ...	92 tons 9 cwt.	96 tons 5 cwt.
Weight of tender in W.O.	56 tons 6 cwt.	56 tons 6 cwt.

An Awkward Load

The conveyance recently of a single lattice steel derrick post, 120 ft. in length and weighing 12¾ tons, provided a transport problem for the L.N.E.R. This abnormal consignment was loaded on a special set of six wagons and the journey from Darlington to Hebburn-on-Tyne had to be made on a Sunday. The trip was successfully completed at a very careful rate of progress. R.S.M.

The Proposed Manchester Tube

The scheme for the construction of a tube railway system in Manchester is going quietly and steadily forward, and it is understood that the Council Committee appointed to examine the proposals is almost ready to lay a definite scheme of action before the City Council. We understand that the Committee favour a scheme for the construction of an outer and inner circle, linked up by lines radiating from the heart of the city.

The financial aspect of the proposals is receiving close consideration, for it is on this that the fate of the scheme depends. The estimate for the full scheme outlined above is approximately £20,000,000, including the provision of stations and full equipment of the line, which is estimated to cost about £250,000 per mile. Of the ground to be tunnelled 75 per cent. consists of red sandstone, the remainder being clay and marl.

At the outset it is probable that the inner circle and one line running from Piccadilly in the centre of the city to Withington, four miles out in the suburbs, will be put in hand. This section would cost not more than £5,000,000 and in its first year's working alone probably would be called upon to deal with 100,000,000 passengers. It is believed that the full 35 miles scheme could be put into full operation within eight years of commencing the constructional work.

* * * *

Electric Locomotive for South Africa

The South African Railways are inviting tenders for the supply of an electric freight locomotive of unspecified design. The authorities are desirous of finding a new type of locomotive for operation on the electrified section of the Natal main line, with a view to improving upon the type at present in use.

The design is left entirely to the tenderer, but, of course, there is a specification of minimum requirements. The locomotive must possess a minimum tractive effort of 66,000 lb. when running at 20-21 m.p.h., and of 21,000 lb. at 35 m.p.h. Its maximum speed must be not less than 45 m.p.h. and it must be capable of starting a train weighing 1,500 tons against a gradient of 1 in 65. The successful manufacturer will be required to supervise the operation of the engine during its first 12 months of operation, but he will have the satisfaction of knowing that, if his first engine proves successful, he will probably be called upon to supply a large additional number.

* * * *

Cockfield Station, L.N.E.R., has been re-named Cockfield (Suffolk).

New "Shire" class for the L.N.E.R.

The L.N.E.R. announce that they have recently introduced a new "shire" class of three cylinder express passenger locomotive engine of the 4–4–0 type for intermediate services principally in the North East of England and Scotland. Twenty-eight of these new locomotives, which are the largest, most powerful and heaviest four-coupled passenger engines in Great Britain, are under construction at the L.N.E.R. Works and it has been decided that the following names will be allocated to them:—Aberdeenshire, Argyllshire, Banffshire, Bedfordshire, Berwickshire, Buckinghamshire, Cambridgeshire, Derbyshire, Dumbartonshire, Fifeshire, Forfarshire, Hertfordshire, Huntingdonshire, Inverness-shire, Kincardineshire, Kinross-shire, Lanarkshire, Lancashire, Leicestershire, Lincolnshire, Nottinghamshire, Oxfordshire, Peebles-shire, Perthshire, Roxburghshire, Stirlingshire, Warwickshire, Yorkshire.

The engines named after Scottish counties will operate in Scotland.

* * * *

Higher Boiler Pressure on L.N.E.R.

Experiments are being conducted on the L.N.E.R. with boilers of higher pressure than those at present standard with the "Pacifics" and other engines. Several engines that have been in the shops recently for general repairs, have been fitted with boilers working at 220 lb. instead of the previous pressure of 180 lb. The first of these is "Pacific" No. 4480, appropriately enough named "*Enterprise.*" Its appearance externally has altered very little and in fact the external dimensions of the boiler are practically unaltered. The barrel plates are, of course, thicker, and in addition a larger (43-element) superheater has been fitted.

The engine has become considerably more powerful. With the increase in the boiler pressure the starting tractive effort at 85 per cent. working pressure is increased by 7,630 lb. to 36,465 lb. The heavier boiler places an additional load upon the axles, so that the adhesion factor is not affected. A slight modification of the Walschaerts gear also has been introduced to secure a longer valve travel. The experimental engines are now working over different sections of the L.N.E.R. to enable comparative figures dealing with the work of the lower and higher pressure engines to be obtained.

* * * *

After negotiations with the principal railway companies, the Postmaster-General has arranged to instal public telephones at the small country stations.

The "Royal Scot's" Performances

Many fine runs have been put up on the "*Royal Scot*" non-stop Euston-Carlisle run, but one among them deserves special mention. Recently the train, driven by James Bilburn of Carlisle, passed Lancaster four minutes ahead of time and between Lancaster and Tebay and Tebay and Shap picked up a further four minutes and two minutes respectively, arriving at Carlisle nine minutes ahead of schedule. The 300 mile run was thus completed in 333 minutes.

The L.M.S. recently announced that some of the night trains are to run between Crewe and Glasgow, 244 miles, without changing engines.

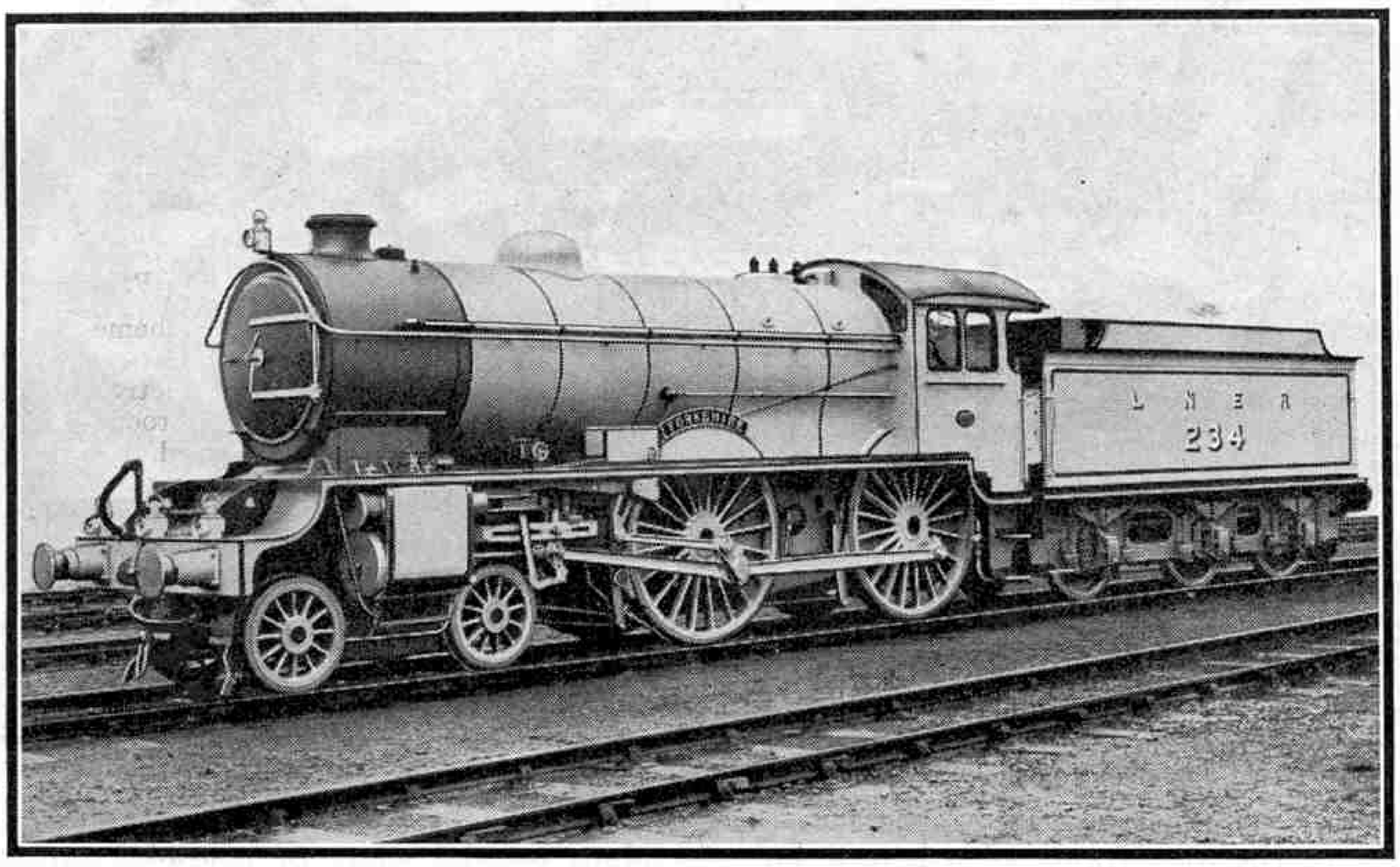


Photo courtesy] [*L.N.E.R.*

New L.N.E.R. 3-cylinder express passenger locomotive, "Yorkshire"

Leading Dimensions of 3-Cylinder 4–4–0 "Shire" Class Engines, L.N.E.R.

Cylinders (three)	Diameter	...	17 in.
,,	Stroke	...	26 in.
Driving Wheels,	Diameter	...	6 ft. 8 in.
Heating Surface,	Tubes	...	1,226.28 sq. ft.
,, ,,	Firebox	...	171.50 ,,
,, ,,	Superheater	...	246.10 ,,
,, ,,	Total	...	1,643.88 ,,
Firegrate Area	... ...	...	26 ,,
Working Pressure	...		180 lb. per sq. in.
Tractive Effort (at 85 per cent. working pressure)	... ...		21,556 lb.
Adhesion Weight	... ...		42 tons
Total weight of Engine	...		66 ,,
Total weight of Engine and Tender			118¾ ,,
Water Capacity of Tender	...		4,200 gals.
Coal ,, ,,	...		7½ tons
Wheelbase of Engine and Tender			48 ft. 5¼ in.

Signal Improvements on G.W.R.

A central signal box and ground frame are to be provided at Neath in place of the existing West and Middle signal boxes. The down main line between the down main home signal and the intermediate home signals, and the up main line between the up main starting signal and the new signal box is to be track circuited.

Relaying a Culvert at Night

During the next few months some 40 or 50 men of the Engineers' Department of the Southern Railway will be engaged in relaying a large culvert 100 ft. below ground level. The work will be done in the middle of the night by the light of huge acetylene flares and at times the men will be working in 2 ft. of running water. The scene of the work is Clayton Tunnel, over 1¼ miles in length and one of the longest tunnels on the Southern Railway. It lies between Hassocks and Preston Park Stations, about seven miles from Brighton on the main London-Brighton line.

This line was originally opened in September, 1841, and when the tunnel was made a large brick culvert was laid down the centre between the running lines to take the drainage water from the south side of the tunnel and the numerous springs that were encountered in the tunnel itself. The culvert was egg-like in shape, varying from 3 ft. to 4 ft. in width and from 3 ft. 9 in. to 5 ft. in depth. At its widest points it ran immediately underneath the sleepers carrying the metals, the bottom of the culvert being about 6 ft. below rail level. Although this culvert was quite strong enough for the traffic that originally passed over it, it has been decided to re-construct it on account of its age and the heavier engines and rolling stock now using the line.

The new culvert will be slightly smaller than the original one, and will be constructed of round reinforced concrete pipes, varying in diameter from 18 in. to 3 ft., the size of the pipes being gradually increased as the various springs in the tunnel are met. Over 1,300 yards of the culvert will be composed of the large size pipes.

The work of opening up the old culvert necessitates the temporary removal of some of the sleepers under the rails, as a wide trench has to be dug extending over the full 6 ft. of space between the running lines, to allow of the large pipes being placed in position. The concrete pipes, which are in sections one yard in length, each weighing about half a ton, are brought into the tunnel on trucks from the dump at Hassocks Station and are lifted into position by a travelling crane. They are being sunk in a bed of cement from 6 in. to 9 in. thick, and as soon as this has hardened the trench is filled in and the sleepers replaced in their final position. All equipment and surplus material has to be cleared from the tunnel each morning before the first train passes through, as there is no space in the tunnel for storage purposes.

This is one of several interesting railway engineering jobs that have been undertaken recently. Details of some smart work on other lines will be given next month.

Miniature Railway Accessories

And How to Make Them from Cardboard, etc.

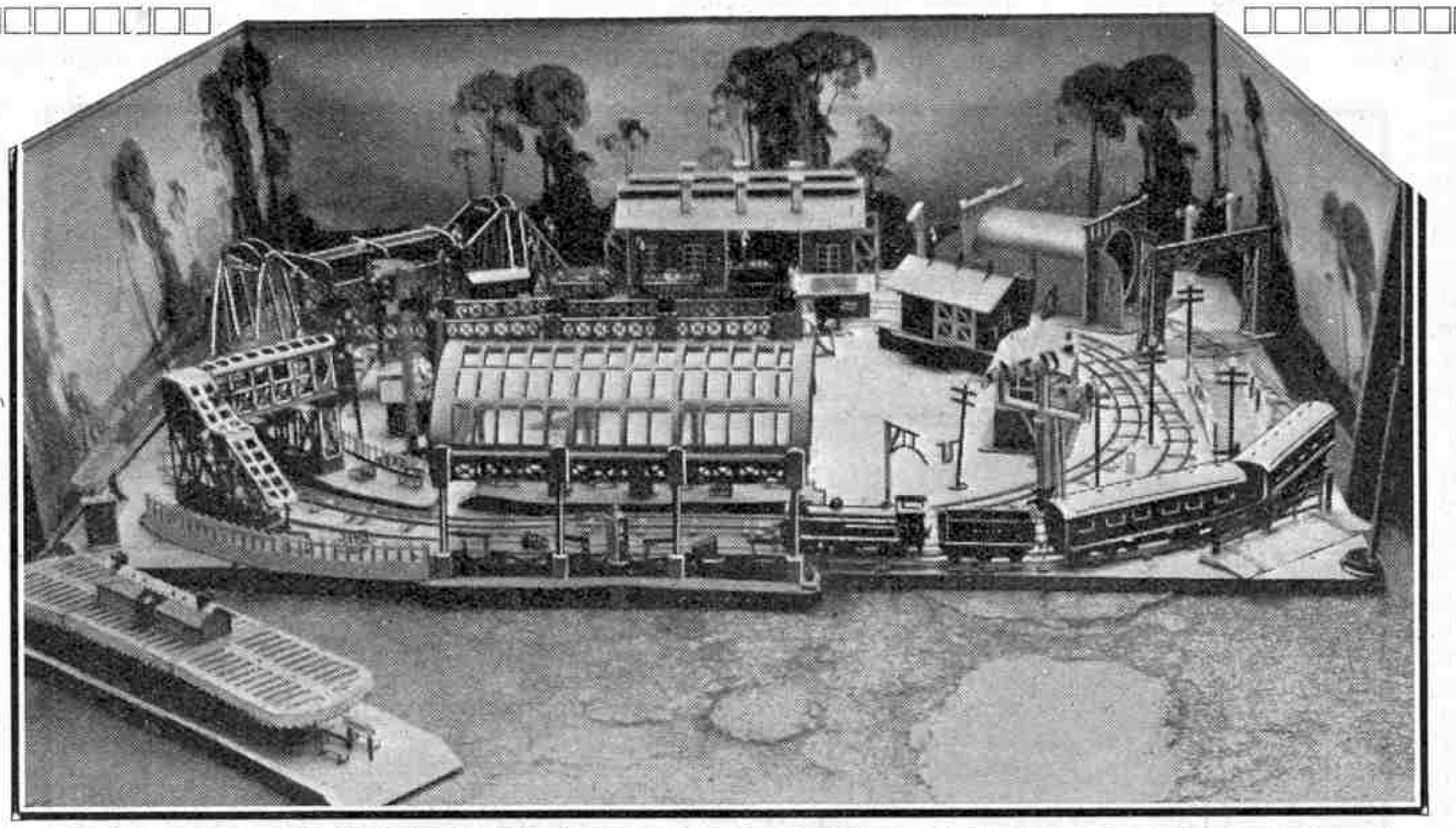


Fig. 1. Mr. Winward's Model Railway Layout. Showing Stations and other Accessories made of cardboard

THE majority of Hornby Train enthusiasts feel at times that they would like to improve their layouts by the addition of structures such as bridges, engine sheds, large terminal stations, etc. There is no doubt that structures of this nature do add very greatly to the appearance of a layout but the question arises as to how they are to be made. Of course they can be built quite well in Meccano, but many Hornby railway owners do not possess a sufficiently large Meccano outfit for the purpose. It is quite feasible also to build these structures of wood, but here again many boys have not the necessary tools, in addition to which wooden structures are liable to be heavy and cumbersome.

Mr. W. Winward, of Higher Broughton, Manchester, a regular reader of the *"M.M.,"* recently brought to our notice his method of construction in cardboard. A special representative of the *"M.M."* called upon Mr. Winward and obtained the particulars upon which the following article is based. This method of construction requires merely a supply of cardboard, some ordinary glue or a tube of Seccotine, a few paper clips and a sharp pen-knife. An old razor makes a very good substitute for the pen-knife, but it is advisable to make sure that it is an old one and not one that father has just got into perfect condition!

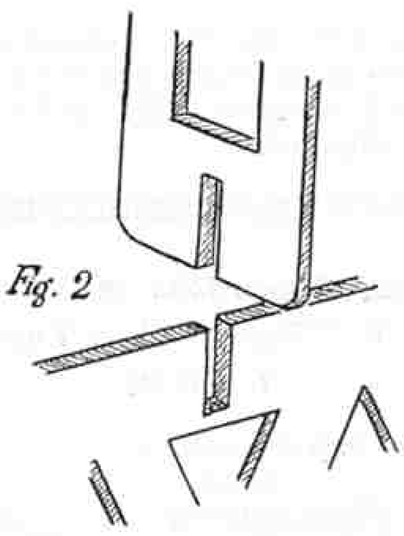


Fig. 2

As cardboard provides the whole of the building material, it is necessary that it should be of good quality in order to secure the necessary rigidity. Suitable cardboard for the purpose may be bought from any paper and cardboard dealer or even from a local printer or bookbinder. Trouble will be saved if the correct specification is given when ordering, namely, "three 30 in. by 40 in. or four 22 in. by 32 in., 1 lb. white lined strawboard."

The term "lined" signifies that one side of the strawboard is covered with white or tinted paper, and this type of board is similar to that used in the making of chocolate boxes and boot boxes. Although the lining is really introduced to prevent the cardboard curling or altering its shape, it will be found easier and more interesting to draw the necessary plans on the white or coloured surface than upon the board itself with its original colour of dirty straw.

If it is impossible to obtain cardboard specially for the purpose, most households will provide a few old cardboard boxes that may be utilised. The cardboard thus obtained will serve the purpose quite well, but there is the drawback that the model when complete probably will consist of various colours and qualities of board, which detracts considerably from the appearance of the structure.

The method of work will be explained most easily by reference to an actual model and we will select for the purpose the viaduct shown in Fig. 1.

It will be observed that the whole structure is built up of sections resembling lattice work and yet all cut from solid pieces of cardboard.

The model really consists of three sections, a centre span and two end sections. These three may be fixed together permanently by thin glue or Seccotine, thereby securing the greatest degree of rigidity and strength, or they may be joined temporarily by means of wire paper clips. The latter plan is the best where space is very limited and where the structure, like the railway layout itself, has to be frequently dismantled and re-built.

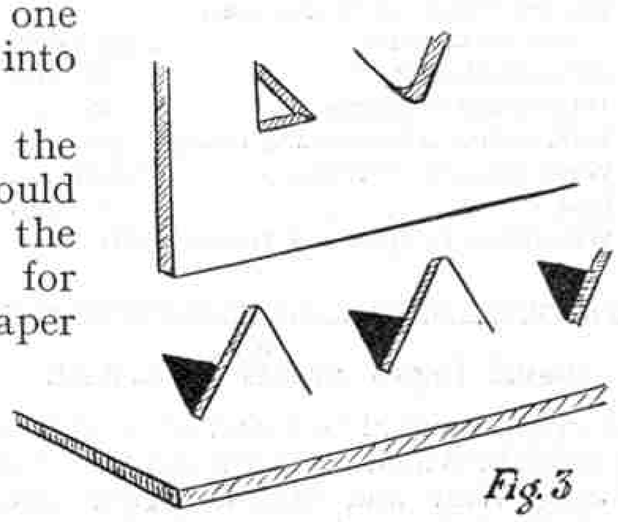
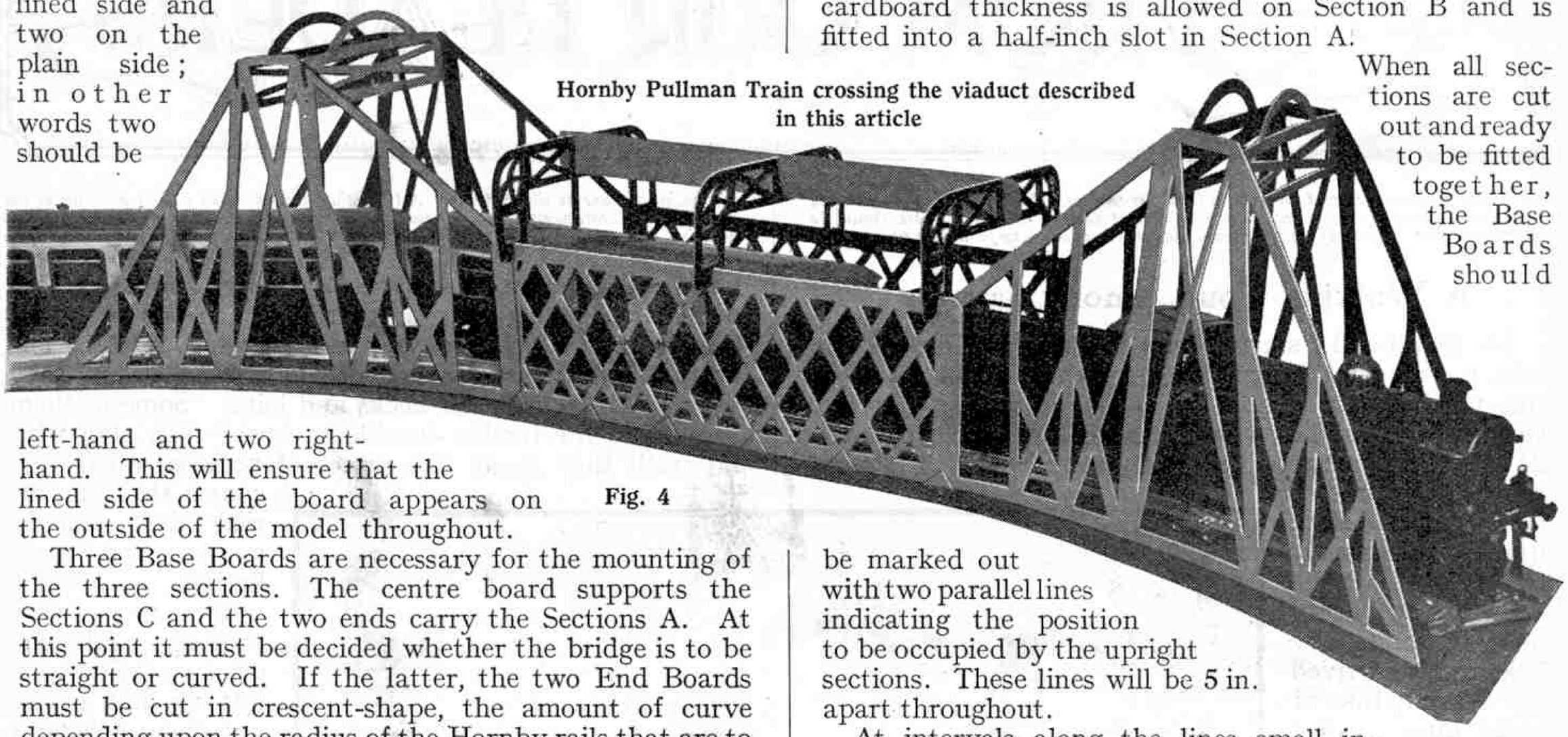


Fig. 3

In all there are nineteen pieces to be drawn upon the cardboard and cut out, exclusive of the Base Boards, which will be dealt with later. This total comprises four End Upright Sections A; four End Transverse Sections B; two Centre Upright Sections C; three Centre Transverse Sections D; two Centre Connecting Strips E and four Joining Pieces for connecting

the three sections. If, as we have advised, the model is being built with lined strawboard, care should be taken that two of the four Sections A should be drawn on the lined side and two on the plain side; in other words two should be left-hand and two right-hand. This will ensure that the lined side of the board appears on the outside of the model throughout.



Hornby Pullman Train crossing the viaduct described in this article

Fig. 4

Three Base Boards are necessary for the mounting of the three sections. The centre board supports the Sections C and the two ends carry the Sections A. At this point it must be decided whether the bridge is to be straight or curved. If the latter, the two End Boards must be cut in crescent-shape, the amount of curve depending upon the radius of the Hornby rails that are to be used. If it is preferred to have a straight bridge with straight rails the End Boards will, of course, be cut straight.

In order to provide a foundation the Base Boards should be drawn and cut with a margin of one inch on every side, the size of each of the boards being 14 in. by 7 in. This margin will produce an overlap at the junction of the three main sections and in order to obtain a perfectly even joint the pieces should be dovetailed, which gives the additional advantage of easy dismantling and re-building.

This model incorporates certain features of interlocking that are rarely met with in cardboard models. Fig. 2 shows the method of connecting the pieces D to the Side Sections C. The principle is that of cutting out of each section a small slot of the thickness of the cardboard itself and $\frac{1}{2}$ in. in length, and then fitting both together firmly, completing an effective joint by a smearing of glue. The same method is employed in the joining of Sections B to Sections A, but in this case a shoulder of cardboard thickness is allowed on Section B and is fitted into a half-inch slot in Section A.

When all sections are cut out and ready to be fitted together, the Base Boards should be marked out with two parallel lines indicating the position to be occupied by the upright sections. These lines will be 5 in. apart throughout.

At intervals along the lines small inverted V-shaped cuts are made as shown in Fig. 3, and these pieces are bent back and glued to form joints between the base and the uprights. The size of these small hinges depends upon the amount of board available at the joint where they are attached to the uprights. For instance, it is no use cutting a one-inch hinge at a joint where only a half-inch of cardboard exists in the upright; on the other hand a substantial hinge may be allowed for at a main joint in the lattice design. The paper clips will be useful when glueing these hinges.

The small strips used for combining the three sections into one measure 4 in. by $\frac{3}{4}$ in. and are attached on the outside of the model at the points where the end sections join the centre portion. As previously mentioned they may be permanently glued or only temporarily attached to the centre portion, an overlap of $\frac{3}{8}$ in. being allowed for the introduction of the end sections.

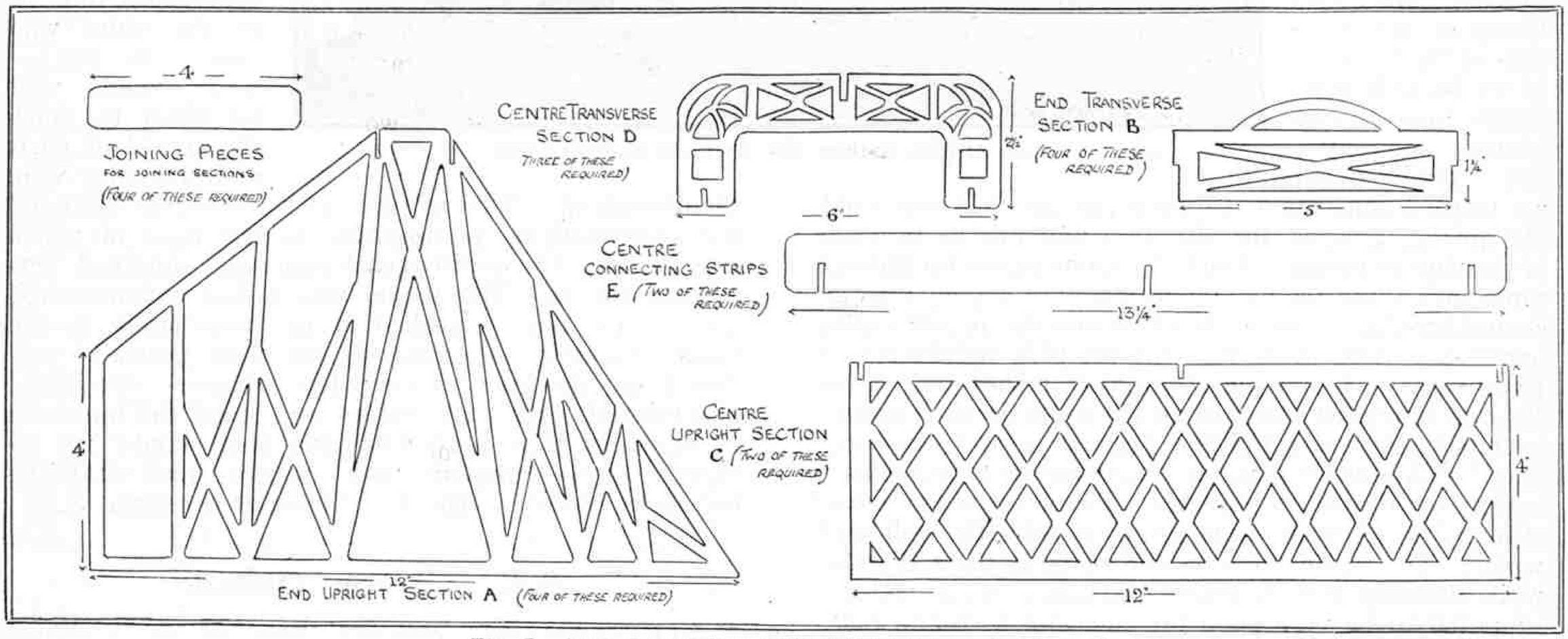


Fig. 5. Plan of sections required for building the viaduct

FROM OUR READERS

These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

A Walking Tour Among Savages

My friend and I started from Pretoria at 8 o'clock one cold morning for Warmbaths, which is about 60 miles due north of the city. We each "humped" our kit, weighing about 30 lb. By five o'clock we had completed 24 miles and, after being greatly refreshed by a passing shower, we had a good meal and slept quite comfortably on the veld. We were away again next morning by 7.30 and we arrived at Warmbaths at night after a very strenuous day.

Warmbaths, as the name implies, is a small town possessing a hot sulphur spring that provides baths very beneficial to people troubled with rheumatism. We had a letter of introduction to the manager of the baths and we sought him out and hinted politely—but broadly—that we wanted somewhere to sleep, as the veld was cold. He quickly grasped the situation and put us into one of the vapour rooms. The hot vapour passes up through pipes into these rooms and by opening a plug that we should have let alone we nearly succeeded in suffocating ourselves! After that, we kept the plug tightly closed. Even then we found the atmosphere rather close so we slept on the cement floor of an adjoining dressing room.

Outside the baths building there is a tap from which may be obtained hot water containing an extraordinary variety of dissolved minerals. People crowded round this tap to fill their large tumblers with the yellowish water. The expressions on the faces of most of them while drinking it were really pathetic, but the water is supposed to be very good for one, and so that's that! Honestly, I have never tasted anything so awful in my life!

The following morning we started off, minus kit, for a day's walk to the Falls, about five miles away by direct route over the hills. On the way we passed through several native villages or settlements. In the largest group of huts there were some 200 natives gathered together for a feast in honour of the return of some of their brethren from a journey. Ten oxen had been killed for the occasion and huge chunks of flesh were being roasted over an open fire. In the meantime beer of their own brewing was flowing freely. The natives had smeared their bodies with red clay and they wore beads round their necks and loins. Some of them had taken the further trouble to smear their skin with fat until they shone like pieces of polished wood! Of course they all carried their shields, assegais and knob-kerries.

South African Natives line up to be photographed

We were very anxious to take one or two snapshots, but we felt rather nervous and thought perhaps we had better not risk it. On our return journey, however, we came across a youth in "civvies" and consulted him about the possibility of a photograph. This youth took us to the chief who said "Oh yes"—if we would wait for them to finish the course of meat in which they were then involved! This we did, and afterwards obtained the accompanying photograph, on the right of which can be seen the polite gentleman who obtained permission for us. The sequel was rather embarrassing, because the natives rushed at us immediately in one mass, evidently expecting to see their portraits produced on the spot! After ten minutes' persuasion, and faithful promises to return and shoot the hundreds of monkeys that were damaging their lands, we escaped safely complete with camera, and thanking our lucky stars! A. D. CUTHBERT (Pretoria, S.A.)

Solid Carbon Dioxide

All gases have now been both liquefied and solidified. The common gas carbon dioxide, perhaps more familiarly known as carbonic acid gas, is comparatively easy to liquefy. The process used in the liquefaction of this gas is called the "cascade" process because other gases are liquefied first.

An easily liquefied gas, such as ammonia, is liquefied by pressure. The liquid ammonia is then circulated round a tube containing another gas under pressure, the liquefaction of which requires a lower temperature.

Suddenly, the pressure on the ammonia is released and the liquid ammonia boils. In doing so it has to take up a great amount of heat, and it obtains this from the tube which it surrounds. Thus the second gas, already under great pressure, is cooled to such an extent that it liquefies.

The second gas, when liquefied, passes around another tube containing carbon dioxide under great pressure. The pressure on the second gas, when in a state of liquefaction, is released, causing it to boil, and the carbon dioxide thereby loses heat and becomes a liquid. Thus by a series of steps a temperature low enough to liquefy carbon dioxide is reached. The liquid carbon dioxide is stored in strong steel cylinders. It might be noted that if the temperature of these cylinders full of liquid reaches about 88°F. there is great danger of an explosion owing to the enormous pressure generated. This may easily happen if the cylinders are left in the sun during transportation.

A few days ago I saw some liquid carbon dioxide. It is similar in appearance to water, except that it gives off white fumes. When the liquid is run out of the tap at the end of the cylinder it immediately boils, since the pressure has been released. As already noted, heat must be absorbed from somewhere during boiling, so that its temperature is still further lowered. This heat it takes from itself causing some of the liquid to be frozen solid.

Solid carbon dioxide is like snow. It can be handled and is very cold. I scarcely felt the cold as I handled it gently. The reason for this is that gaseous carbon dioxide was constantly coming off because of evaporation. Thus there was a film of gas between the solid carbon dioxide and my hand, which almost completely insulated my hand from the extreme cold. I was told that if I squeezed it it would give me a very nasty scar similar to a burn. Needless to say I did not try the experiment!

ALAN O. ROBSON (Sydney).

Life in Hongkong

I originally lived in Portsmouth and the change to Hongkong was a pretty big one. I actually live in Kowloon, which is on a peninsula on the mainland opposite the island of Hongkong. Behind Kowloon rises a range of mountains the highest peak of which is called Lion Rock, and the railway to the city of Canton runs through a tunnel bored under this mountain. A range of mountains also runs down the centre of Hongkong, Victoria Peak being the highest point. At its foot is Victoria, the chief town of Hongkong, and an electric railway runs through the town to near the top of the Peak. The carriages are somewhat like single-deck tramcars, and when one is travelling up the mountain objects outside the carriages seem to be falling backward.

There are many fine beaches in Hongkong and Kowloon. The water is much warmer out here than in England and I have learned to swim a little since I arrived. Journeys between Hongkong and Kowloon are made by steam ferry-boats having two decks, the upper being first-class and the lower for natives only.

Recently there occurred a typhoon, a very violent storm of a kind peculiar to the East Indies. Considerable damage was done in Hongkong and Kowloon, and at the latter place a garage near the ferry was completely smashed up. The strength of the wind was terrific, and I saw a man literally blow over. I am told that since we came here the weather has been extremely bad, and I am hoping that it will soon become normal once more.

F. STOAKES (Hongkong).

A Street Scene in Hongkong

How Bells are Made

The roundness of tone with which a bell rings depends to a large extent upon the proportions in which the metals of which it is made are mixed. The metals chiefly used in bellmaking are copper and tin, for experience has shown that these are the only metals capable of producing a proper ringing alloy. The introduction of iron and steel results in the production of harsh sounds, while silver and gold tend to produce a thud rather than a ring.

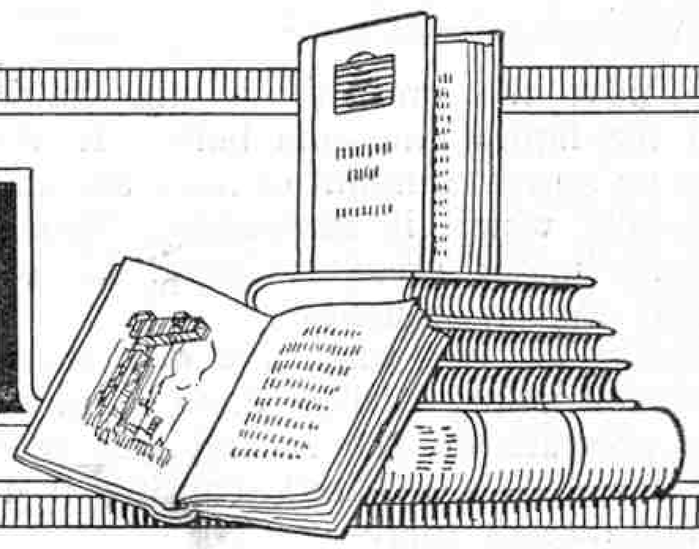
The manner in which bells are made is briefly as follows. Two moulds, one fitting inside the other, are made, the outside of the smaller one being evenly coated with a layer of clay and sand, while the inside of the larger one is similarly treated. The moulds are then clamped together and, owing to the shaping of the clay and sand on the surfaces, a space is left into which the molten metal may be run. After the metal has set the moulds are carefully removed.

Different notes require different sizes of bells, a high note needing a small bell and a low note a large one. The reason of this is that the rim of the bell when struck sets up vibrations or waves in the surrounding air which, according to their frequency, give rise to a note of high or low pitch. The more rapid the vibrations the higher is the note produced.

Although all bells intended to produce a certain note are cast in the same mould, their pitch often varies slightly as the result of small individual differences. These differences have to be carefully adjusted by the aid of a tuning fork. In order to lower the pitch the inside of the bell is carefully ground away, thereby increasing the inside diameter; while to raise the pitch the rim is trimmed, thus decreasing the outside diameter. This trimming, of course, is a delicate operation and one that requires great care, for by taking off too much one way or the other the bell would be ruined. When a group of bells, for a belfry, for instance, are being tested, the trained ear of the tester is alone relied upon to ensure their being in harmony with one another.

F. HOCKING (Notting Hill, W.11).

Books to Read



Readers frequently write asking if we can recommend books that are both of interest and of use. On these pages we review books that will specially appeal to readers of the "M.M." We do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"Bird Life at Home and Abroad"

By T. A. COWARD, M.Sc.
(Fredk. Warne & Co. Ltd. 7/6)

In this volume Mr. Coward, already well known as a writer on bird-life, has given us a great deal of interesting material—more particularly interesting, perhaps, because it deals also with birds beyond the shores of the United Kingdom. It is a pleasant change to learn something of our near neighbours in bird-land, and here we read of the Flamingo in France, of the birds of the Bay of Biscay, of those on the dunes and marshes of Holland, and of the birds in the Pyrenees, as well as of our British birds. There is also a chapter that deals with the "rights and wrongs" of egg-collecting and the final chapter of the book is devoted to problems that arise in connection with the protection of our feathered friends.

Wild birds are in a different category from other animals for they are given legal protection for their own sakes. The author points out that the question of sport and property enters largely into this matter of protection. The bird must be preserved for the sportsman, not only to save its life, but to hand the power of life and death into the keeping of others. Then again birds are protected to prevent their being exploited by the egg-collector, the specimen-hunter, and the one-sided sportsman. These foes are far more serious than the birds' natural enemies, which themselves reduce the actual stock of birds at an alarming rate.

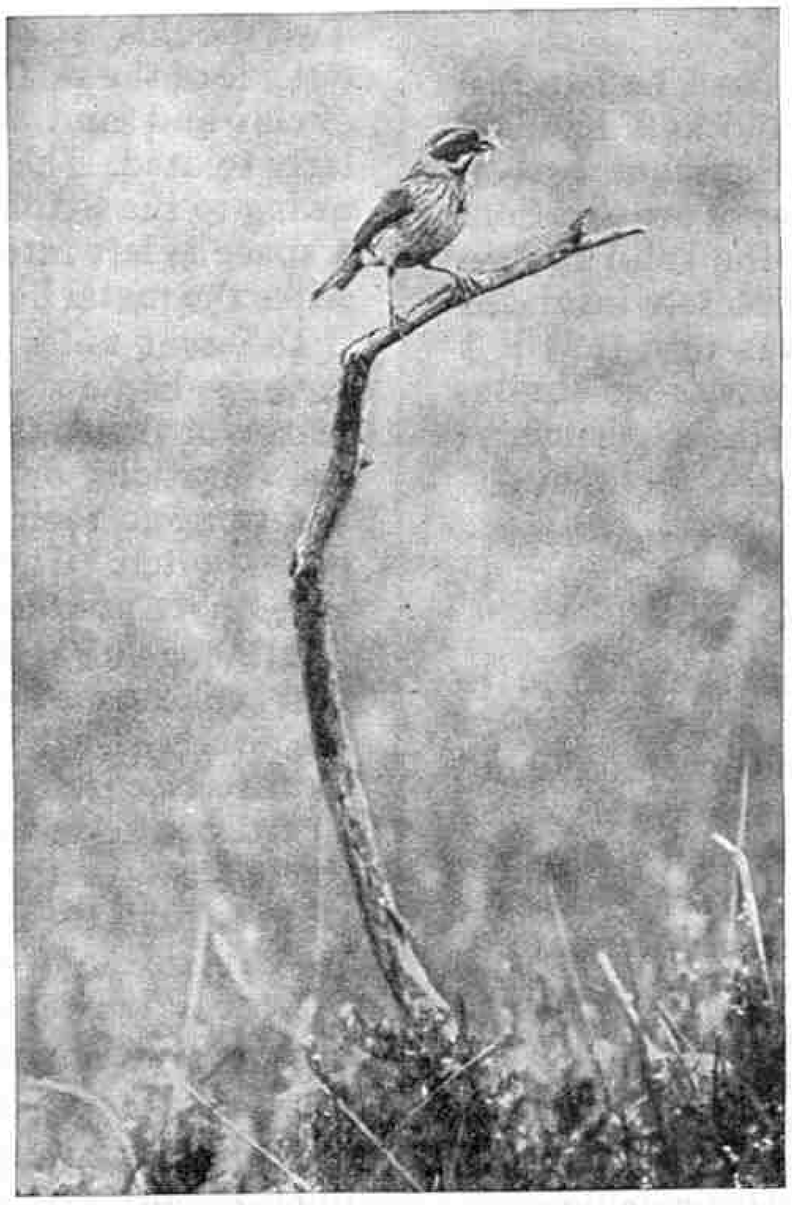
The book is illustrated with 24 photographs, which are admirably reproduced, and there is a coloured frontispiece of Flamingoes at home.

* * * *

A British Railway's Link with U.S.A.

In connection with the Baltimore and Ohio Railway Centenary, which occurred last September, the Great Western Railway sent two locomotives to the United States to take part in the ceremonies. These locomotives were "*King George V*," the most powerful British passenger express locomotive, and the reconstructed veteran "*North Star*" built by Robert Stephenson & Co. To commemorate their part in the celebration the G.W.R. have issued an attractive souvenir booklet that tells the interesting story of the development of "Brunel's Line" from its beginning in 1837 up to the present day. In addition, the booklet deals with the principal places of interest on the G.W.R. main lines and the part played by the railway in the commercial and industrial life of Great Britain and America.

The Oyster Catcher, with eggs and young (see below)



The Reed-bunting. The two illustrations above are from "Bird Life at Home and Abroad" reviewed on this page

"Scouting on Two Continents"

By MAJOR F. R. BURNHAM
(Published by Heinemann. 15/-)

The author, who at one time was Chief of Scouts under Lord Roberts, was born of pioneer parents on the Western American frontier. Early in life he became skilled in scout lore and the use of firearms, and it is well he did so for his knowledge was often required to get him out of a tight corner.

After living on the frontier for 30 years he left America to join Cecil Rhodes in Africa, where he soon found himself in the midst of the first Matabele War. The shooting of the Matabele high-priest M'Limo and the Boer War provide the material for the remainder of this thrilling narrative, which with the story of his exploits in the Jameson Raid, makes thrilling reading.

Sir Rider Haggard once paid the author a high tribute when he said "Burnham in real life is more interesting than any of my heroes of romance." We can readily believe that this appreciation by the author of "*King Solomon's Mines*" was no idle compliment. Of him Sir Robert Baden Powell, the Chief Scout, once wrote: "He is a most delightful companion . . . amusing, interesting, and most instructive. Having seen service against the Red Indians he brings quite a new experience to bear on the scouting work here; and while he talks away there's not a thing escapes his quick roving eye, whether it is on the horizon or at his feet."

Cattle-lifting, Smugglers, Gold-mining, Carrying Dispatches, A Dash to Capture the King, Wilson's Last Stand, Rhodesia's Darkest Hour, and Cutting the Railroad, are but a few of the chapter titles of this well-illustrated volume. Our readers—and particularly those who are Scouts—will find in this book a thrilling story of adventure that will at once make a direct appeal.

* * * *

"New York in Seven Days"

By H. S. MAYTON and L. B. BARRATT
(Published by Mills & Boon. 7/6)

This excellent guide for those who may have but seven days in which to see New York, consists of 161 pages, with an excellently arranged index and one large and six sectional maps. Although it may not fall to the lot of many of our readers to have the pleasant experience of visiting New York, yet there are no doubt many who wish to learn something

about London's rival city, and this book will help them to do so.

No matter whether the reader's taste be for ancient churches, Chinese quarters or the latest engineering achievements, he will find the information he seeks within the covers of this book. The Chinese restaurants are "all clean and have good food. Walking upstairs we found a large room with another dining floor above it. They were filled with teakwood tables inlaid with mother-of-pearl, and also little teakwood taborets decorated in the same way. Along one side of the room we saw red lacquered booths with embroidered panels—delightful little niches for a cosy chat." The menu that our guide chooses certainly arouses one's spirit of adventure:—"one portion of chicken chop-suey; one of almond chow mein; one of rice; tea rice cakes, and assorted fruits"—this the author claims is sufficient for four persons—which we can well believe!

Readers of the "*M.M.*" will be specially interested in the bridges of New York. Brooklyn Bridge "still leads a useful existence though it was the first built in New York. It has been considered one of the world's wonders and a gigantic feat of engineering. Constructed during a period of thirteen years beginning in 1870 it is largely the product of the indomitable will of the injured son of the builder, who directed its completion by the use of a telescope from his window in Brooklyn Heights. It is over a mile long. Just north you will see the Manhattan Bridge, then the Williamsburg Bridge and still to the north is the new Queensboro' Bridge, noted for its carrying capacity."

Whether one hopes to visit New York or not, this is a book that will be read and enjoyed by many.

* * * *

"Northward Ho!"

By Dr. Stefansson. (Harrap. 3/6)

This book is the story of an explorer who has helped to gather facts about the Arctic coast during the 10 winters and 13 summers he has spent in the Arctic regions. He has travelled thousands of miles to and fro, has sailed along rocky shores, clambered over mountains and skimmed on snow-shoes across frosty plains. He has trudged for months over tumultuous seas of ice, and again has walked knee-deep among millions of wild flowers.

Dr. Stefansson has lived with Eskimos who have learned to drink tea and use the latest style of rifle. He has discovered others who had never seen a white man until they greeted him. He has worn furs and eaten frozen raw fish, and has gained weight on a diet of caribou meat and seal fat. He has explored strange rivers and discovered large islands whose existence was before then not even suspected.

Having done all this he has set down some of his experiences in this little book, and readers will agree that there is no man better qualified to tell us about the fascination of the far north and its people than Dr. Stefansson. Those readers who are interested in our series of articles on "Arctic Exploration" could not do better than supplement them by reading this book.

An old hunter describing his adventures, a picture record of which has been carved on walrus ivory. (From "*Northward Ho!*" reviewed on this page)

* * * *

"The Romance of Great Businesses"

By W. H. Beable. (Heath Cranton. 15/-)

It is evident that there are "Dick Whittingtons" living in Great Britain to-day and it is obvious, too, that there is as much glamour in the stories of their achievements—as set out in this book—as there is in the legend of the boy who heard Bow Bells ringing "Turn again, Whittington—Lord Mayor of London!"

Romance is all around us, even in prosaic business life, and we cannot help but be interested in these "peeps behind the scenes" in the stories of things we eat, drink, wear and use that this book contains—there are no less than 34 modern romances, each of which proves that truth is stranger than fiction.

All are stories of famous men and the businesses they built up—names familiar in every household. As Lord Riddel says in his foreword, the book is an entertainment, an example and an inspiration. Here is told the story of such products as Sunlight Soap, Skipper Sardines, and also of the businesses of W. H. Smith & Son, Cadbury's, Pears, Lyons, Horrocks, Huntley and Palmer's, Whiteley's and other well-known firms. Although these stories are all of British men, firms and products, there are probably equally interesting stories to be told of the French, American and many other international enterprises that have a foothold in this country—as the author points out.

Obviously there is much to learn from successful enterprises and the conclusion one draws from a perusal of the book is that nearly all successful businesses have risen from small beginnings, and that they have been built up by careful attention to detail, sound advertising, and genuine service to the public.

The book is one that will particularly appeal to those who intend to make their mark in the business world and who are interested in learning how others have succeeded in doing so.

* *

"Drake's Twin Sea-Cubs"

By Ernest Protheroe (Sharp. 3/-)

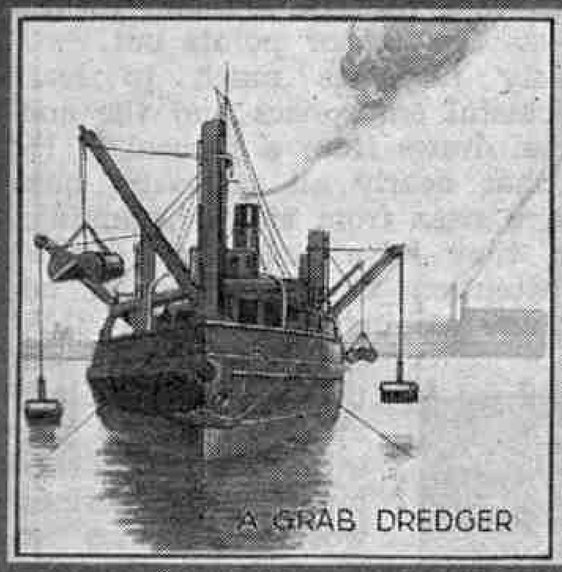
A voyage to the Spanish Main, with John and Francis Drake, accompanied by John Oxenham is surely in itself adventure enough for two young boys. But when the adventure is undertaken by running away and stowing aboard John Drake's ship it becomes even more exciting!

The red-headed twins were so alike that even their Mother had difficulty in distinguishing Bob from Dick, and this likeness served them in good stead. They had stowed away in the hold, amongst casks of biscuit and meat—anything but a pleasant cabin for the journey, especially when the ship was rolling on a rough sea. No wonder then, that a sailor, going below for provisions, fled, shrieking at the sight of a white-faced, red-headed ghost! He was ordered back to discover more about the spectre, but was too afraid to venture below again, whereupon one of the carpenters was sent to investigate the matter, and returned to the deck holding the very sick-looking "ghost" by the arm!

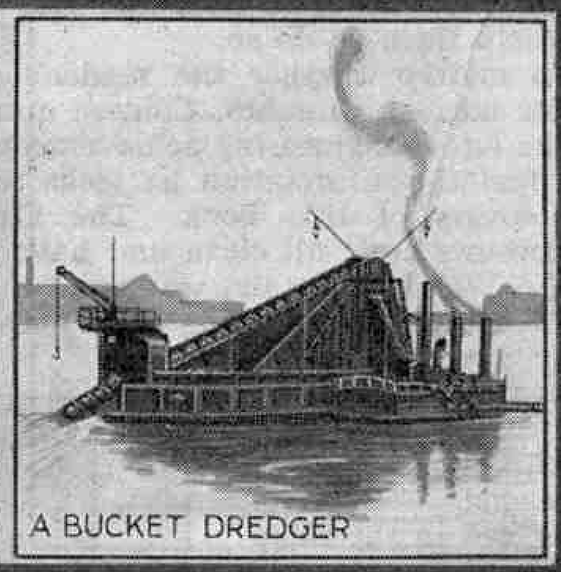
Bob did not divulge his brother's presence in the hold, and as the ship was short of a hand, he was allowed to help the cook, and also serve John Drake himself. Then, with the aid of the cook (who was an old acquaintance of his) he contrived that for one day and night *he* should perform his duties and serve Drake, then retire below and let Dick take his place, having instructed Dick carefully in the happenings of his spell of duty, so that the suspicions of the crew—and most of all of the Commander himself—should not be aroused by any slips or lapses of memory.

All went well until Dick cut his finger. Next day Bob had to bandage his finger—naturally! That part was easy enough, but "fake" bandages have a habit of slipping off unnoticed and exposing a perfectly sound finger to an eagle-eyed Captain's gaze—then the truth was out!

So began the twins' adventures—fights with sharks and Spaniards; attacks on mule-trains laden with gold and silver; and many other thrills in store for the reader.



ENGINEERING NEWS



Proposed Birmingham-Birkenhead Motor Road

A provisional committee has been formed to consider the practicability of a project for the construction of a motor road 120 ft. in width from Birkenhead, through the Potteries district, to Birmingham. The total length of the road would be 90 miles and the estimated cost £6,000,000.

The object of the road would be to provide an expeditious through route for road-borne merchandise between the Midland towns and the Merseyside docks. In fact, although the scheme has emanated from the Midland area, it may be said to form an adjunct to the new tunnel being driven under the River Mersey. The corporations of Wolverhampton and of the five towns in the Potteries area already have signified their support of the scheme, and a conference recently took place between officials of the Birmingham and Birkenhead Chambers of Commerce, at which were present representatives of the Mersey Docks and Harbour Board and the L.M.S. and G.W. Railways.

* * * *

Birmingham-Wolverhampton Road

The completion of an important road-making scheme took place early in November, when the Prince of Wales performed the official opening ceremony of the new Birmingham to Wolverhampton road. The road has been under construction for nearly four years, and has a total width of 100 ft. throughout its 9¾ miles of length. It has cost just under £570,000. The main carriage way is 40 ft. in width and is flanked on each side by a grass verge 20 ft. in width, which provides the margin for enlarging either the 10 ft. footpaths or the carriage way as required in the future.

* * * *

Halifax-Vancouver Motor Road

To commemorate the celebration of the Canadian Confederation Diamond Jubilee it is proposed to complete the great trans-continental motor road from Halifax, Nova Scotia, to Vancouver, British Columbia, by constructing the sole remaining link across the gap between Fort William, Ontario and Winnipeg. This stretch is 235 miles in length.

* * * *

New Thames Bridges

The Middlesex County Council have applied to Parliament for sanction to build three new bridges over the River Thames at Chiswick, Richmond and Hampton Court. The work is to be undertaken by a Joint Committee of the Surrey and Middlesex County Councils, and 75 per cent. of the cost will be met by the Ministry of Transport.

Nothing further has transpired with another much-discussed Thames Bridge scheme—that at St. Paul's. Negotiations are proceeding between the City Council and the Ministry of Transport, and pending the outcome of these the Council do not propose to take any action.

* * * *

Newhaven Pier to be Reconstructed

The Southern Railway Company have decided to proceed immediately with the reconstruction of the East Pier at Newhaven. This was built nearly 50 years ago and is a timber structure sheeted up to 5 ft. above low water level to act as a groyne to prevent the sand and shingle from silting up the harbour mouth. It has been extended once since it was originally built, and is now just over 500 yds. in length. The new pier will be built of reinforced concrete throughout and will follow generally the same lines as the present structure. The estimated cost of the work is £100,000.

* * * *

Building Canada's Ships in Britain

The Canadian Government within the past few months have placed orders with Cammell Laird & Co. Ltd., of Birkenhead, for five new steamships. The order is of the total value of over £1,250,000 and was secured in keen competition with shipyards outside Britain.

The Canadian Pacific Railway also are purchasing ships from Great Britain, and at present five cargo ships and four 18,000 ton liners are being built on the Clyde. One of these, "*The Duchess of Bedford*," will be launched from Clydebank on the 24th of this month. Another Canadian contract secured by a British firm is for five Canadian lake steamers, each of 2,300 tons dead weight. These are being built by Messrs. Swan, Hunter & Wigham-Richardson of Wallsend-on-Tyne.

In connection with the C.P.R. work it is interesting to learn that altogether the Canadian Pacific Railway have spent £20,000,000 on ships built in the United Kingdom. Most of those ships have been built on the Clyde and the greater portion of the money has been spent in post-war years.

* * * *

Beardmore-Caprotti Valve Gear

At the luncheon following the completion of the recent trials of the Brazilian motor-ship "*Itapé*," Mr. Alexander Galbraith, of William Beardmore & Co. Ltd., disclosed some interesting details of the experimental work that had been carried out by the firm with the Caprotti valve gear. This gear, which will be familiar to most of our readers in connection with the recent trials on the L.M.S. Railway, has been adapted for use with marine propelling machinery.

In comparison with the performance of the ordinary reciprocating marine engine, a Caprotti-fitted engine secures a fuel saving of 10 per cent. with a reduction of 15 per cent. in weight and of 20 per cent. in engine-room space. An engine of this type has been installed in a cargo ship recently completed by Beardmores and is to be tried out. Experiments have been conducted also with a Bauer-Wach type exhaust turbine, and for this it is claimed that a fuel economy of 25 per cent. is secured.

Mr. Galbraith stated that a 5,000 shaft h.p. triple-expansion steam engine using saturated steam would require 58.3 tons of fuel per day. With the Beardmore-Caprotti engine this figure would be reduced to 48.3 tons, and to 39.3 with the Bauer-Wach turbine.

* * * *

The Post Office Tube Railway

Further details of this unique railway—the only installation of its type in the world—are now available.

Between the stations the tube is 9 ft. in diameter and runs at a maximum depth of between 70 and 80 ft. beneath the level of the streets. There are two railway tracks, one for east-bound and the other for west-bound traffic, each of 2 ft. gauge. The rolling stock consists of 90 steel motor wagons driven by current collected from a conductor rail, and each wagon has a carrying capacity of about 10 cwt. The electric trolley wagons will be capable of speeds up to 35 miles per hour, and it will be possible when all the wagons are in use to deal with a "peak" load of 45 tons.

No signals are necessary, as the "live" rail is divided up into sections, each of which automatically becomes "dead" as the train leaves it and "alive" again as the train enters the next section but one. There will thus always be a "dead" section between successive trains, and any possibility of a collision will thereby be avoided. The mails will be hauled to and from the surface almost entirely by mechanical power, spiral chutes being provided for downward mails and lifts for upward mails. Mechanically-operated conveyor bands will also be used for carrying the mails between the bottom of the chutes and lifts and the trains, and for feeding the mail bags on to the platform trollies at the surface.

* * * *

With the object of boosting the Manchester Ship Canal overseas, a film has been prepared telling the story of the canal's construction and its work to-day.

New Lorry with Six-Wheel Drive

The Four-Wheel Drive Lorry Company have recently introduced a six-wheel vehicle, in which the drive is transmitted to all the wheels. This is the first commercial vehicle of this type to be produced in this country and when exhibited at the recent Commercial Motor Transport Exhibition at Olympia, it aroused considerable interest.

The suspension design conforms to the War Department specifications laid down in connection with the scheme under which the owners of approved six-wheel lorries gave to the War Department an option to commandeer their vehicles at an agreed figure in times of national emergency, in return for an annual subsidy of £40. In addition, several interesting features to increase the efficiency and usefulness of the chassis have been incorporated.

The drive to the front axle may be disconnected or re-engaged at will by the movement of a lever, so that when covering solid ground the lorry can be propelled by the four rear wheels and when on soft ground all six can be called into action, thus securing 100 per cent. adhesive weight. This feature is of particular advantage in cross-country work, where the front wheels are liable to stick on banks. With the front wheel drive this difficulty is overcome.

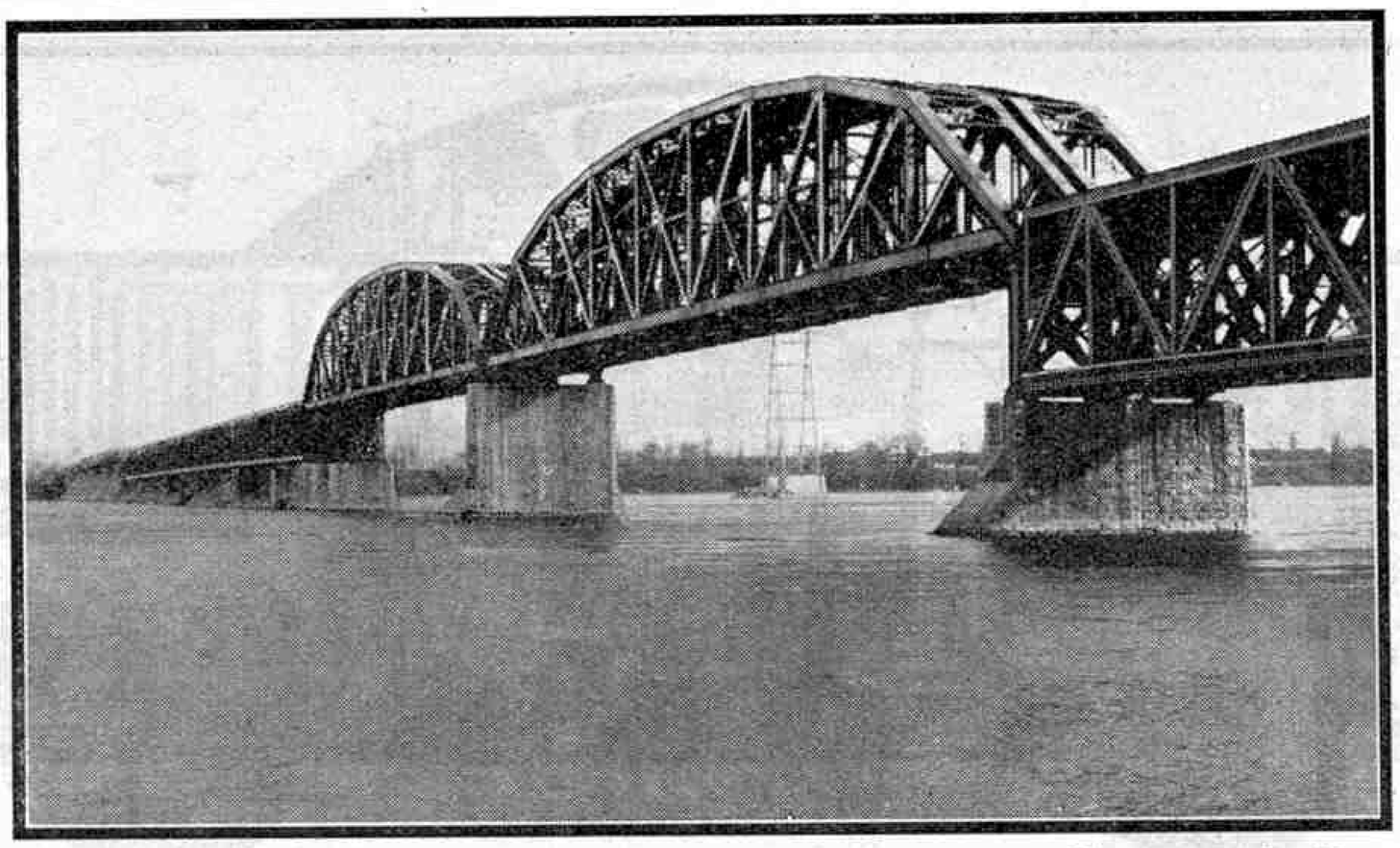
As we have stated, the suspension of the axles conforms to War Department patterns, shackles being mounted on the axles by means of trunnion bearings. They are free to slide outward on the axles but are held in a central position as the shackles are borne against a collar fixed on the ends of the axle casing. The vertical movement of the axles is restricted by rubber pads placed above and by steel cables below. This system of suspension permits the car to achieve some remarkable work over rough ground, and photographs of the vehicle in action in early trials show the various axles tilted in varying directions, often at an angle of 30 degrees from the ground, while throughout the plane of the chassis has remained horizontal.

The lorry is fitted with a four-cylinder engine of which there are two types available, one rated at 36 h.p. and the other at 42 h.p. The main gear box is placed centrally upon the sub-frame, but to provide the exceptionally low gear ratios necessary on heavy going, an auxiliary two-speed silent chain gear box is interposed. The main gear box is of the constant mesh type, giving three forward speeds at the following ratios: direct, 1 to 1, 2 to 1 and 4 to 1, and in reverse 4.12 to 1. The former is a transmission brake of the external contraction type mounted on the main shaft at the rear of the gear box and it is effective on all six wheels. The hand-brake operates on the four rear wheels. All the wheels are interchangeable and are fitted with 40 in. × 8 in. giant pneumatic tyres.

Proposed High-Speed U.S. Atlantic Liners

A scheme for the construction of ten 20,000-ton trans-Atlantic liners has been laid before the United States Shipping Board, with a view to securing financial facilities to permit an early commencement of the work.

According to a New York report, the new ships will cost approximately 3½ million pounds each. They are designed for a length of 800 ft. and a beam of 80 ft.



The Canadian Pacific Double-track bridge across the St. Lawrence River, near Lachim, Quebec

The latter figure is exceptionally small, and is a specially interesting feature of the attempt to reduce resistance and secure very high speed performances. Twelve boilers are to be built in, each working at 400 lb. pressure, and it is understood that the aim is to make the Atlantic crossing in four days. Little time is to be wasted in port each year, for the cargo facilities and discharging appliances are on such a scale as will permit of a complete turn round being made within 12 hours of arrival. Allowing for one month lay-up for reconditioning each year, each vessel will make about 37 round trips per annum.

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New Motor Ships for Germany

The Hamburg-American line are making a bold bid to restore German shipping to its pre-war eminence and at present have 19 large motor ships under construction which are intended to run on all the company's routes, serving principally the U.S.A., Canada, Australia, South America, and the East. One of the ships, the "*Rheinland*," is already on its maiden voyage to Japan, and as it differs from most of the others in that it is intended purely for cargo work, its maiden trip is being followed with unusual interest as affording an indication of what the remaining 18 ships will accomplish.

All these vessels are built to a similar design, although their minor details vary considerably. The "*Rheinland*" has a gross tonnage of slightly under 7,000 and is intended for the Australian and Far Eastern services. Her designed speed lies between 13 and 14 knots, and when the engines are "run in" they are expected to maintain the latter figure with ease. She is propelled by double acting Diesel engines developing 4,500 shaft h.p.

Straightening a 180 ft. Chimney

The difficult and dangerous task of straightening a leaning chimney stack 180 ft. in height has just been successfully carried out by a well-known North of England firm of steeplejacks. The chimney, which for 40 years has been a familiar landmark in the Wigan district, leaned some 30 inches out of the perpendicular towards the cotton mill buildings and the engine house, and had become a standing menace to the extensive factory. The tilting had been caused by local mining subsidences. The chimney, 180 ft. in height and 60 ft. in circumference at the base, weighs over 1,000 tons and contains more than 250,000 bricks.

Workmen were busily engaged for ten days preparing for the final straightening operation. To prevent the possibility of the bursting of the lower portion of the structure, the shaft for some distance upward was strapped with strong iron bands joined together with huge nuts and bolts, which allowed for expansion and contraction by variations of temperature. Long chisels and heavy sledge hammers were brought into play to cut out the bricks at the base of the chimney on the side opposite to the lean, and in the cavity thus formed, which went more than halfway round the stack, 35 special jacks were inserted. Each of these was manipulated separately, so that the operation of lowering the base to restore the structure to the perpendicular might be done with such nicety as to be almost imperceptible.

Steadily the jacks were operated and gradually the chimney was moved the required amount. Finally a steeplejack climbed to the top and lowered a plumbline, thereby proving that the attempt had been successful and that the great shaft once more was perfectly upright.

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Clyde Shipbuilding Boom

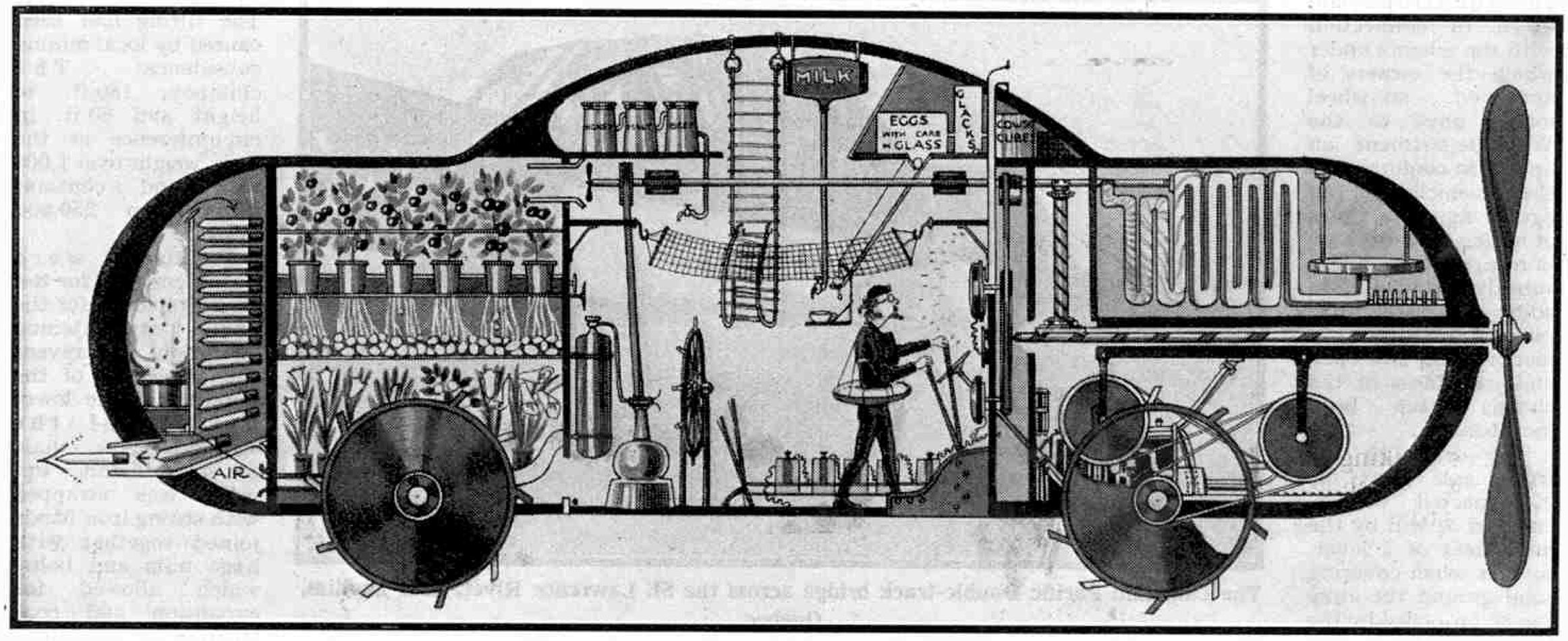
The shipbuilding tonnage output for the month of November last on the Clyde constituted a record for any month since the close of the War. New ships to a total of 25, aggregating 73,000 tons, were launched. This included a 21,000 ton liner for the C.P.R. (mentioned elsewhere in these notes) and a 12,000 ton oil tanker for one of the Standard Oil group of companies.

Including these figures, the total number of ships launched on the Clyde during 1927 up to the end of November was 199, totalling 406,656 tons, as compared with a total for the whole of 1926 of 173 ships of 287,244 tons. Thus, with a month still to go, 1927 was considerably ahead of the previous year. The 1927 output exceeds that of any year since the short-lived boom at the close of the War, and it would seem from these figures that rapid strides are being made toward attaining something approaching a normal state of trade.

By Rocket to the Moon

Famous Scientist's Great Scheme

By R. Frank



THE rocket in which Professor Barmidotti, the famous scientist, intends to explore the farther side of the moon, which is always hidden from our view, illustrates in many ways the advantage of having great schemes of this kind carried out by a scientist of repute instead of by an ordinary inventor. As the Professor himself says, ordinary inventors spend a vast amount of time and money—the latter usually extracted from other people—in making one model after another and even then they almost invariably fail to reach the stage of practical production.

The schemes of a genius like Professor Barmidotti originate in brainwaves of great intensity. They come to maturity with incredible rapidity, and finally burst upon an astonished world in a blaze of coruscating brilliance. The schemes of the ordinary inventor, on the other hand, result from mere ripples on the grey matter of the brain. These ripples or temporary titillations are utterly superficial and it is not surprising, therefore, that projects arising from such trivial sources generally end in nothing more than the production of a few thousand cubic feet of hot air.

Professor Barmidotti with characteristic generosity recently gave a detailed explanation of his wonderful rocket to an admiring audience. The preliminary part of his discourse was quite understandable and therefore excited no particular interest. As the Professor proceeded, however, his hearers gradually became more and more bewildered and finally, having lost all sense of time and space, they realised that this invention was—and, indeed, must be—representative of all the amazing triumphs of modern science.

To call this marvellous contrivance a rocket is to give an entirely false impression, for it combines all the good points of a tank, an airship, a submarine and—a camel. As may be seen from our sectional drawing, it has a hump in which is stored a reserve supply of nourishment to be used in crossing the vast deserts that the Professor expects to find on the Moon. It is provided with large wheels fitted with rims having paddle-like blades attached, to enable them to obtain a firm grip on the loose sand. It might be thought that the vehicle would be helpless if by any chance it found itself in water, but this is not the case. With the foresight that is so characteristic of great genius, the Professor has invented an ingenious arrangement by means of which the blades may be made to project at right-angles to the rim, thus forming very efficient paddle wheels. At the front is a tractor propeller for use when the vehicle becomes an airship—a transformation that is one of the most wonderful features of the invention.

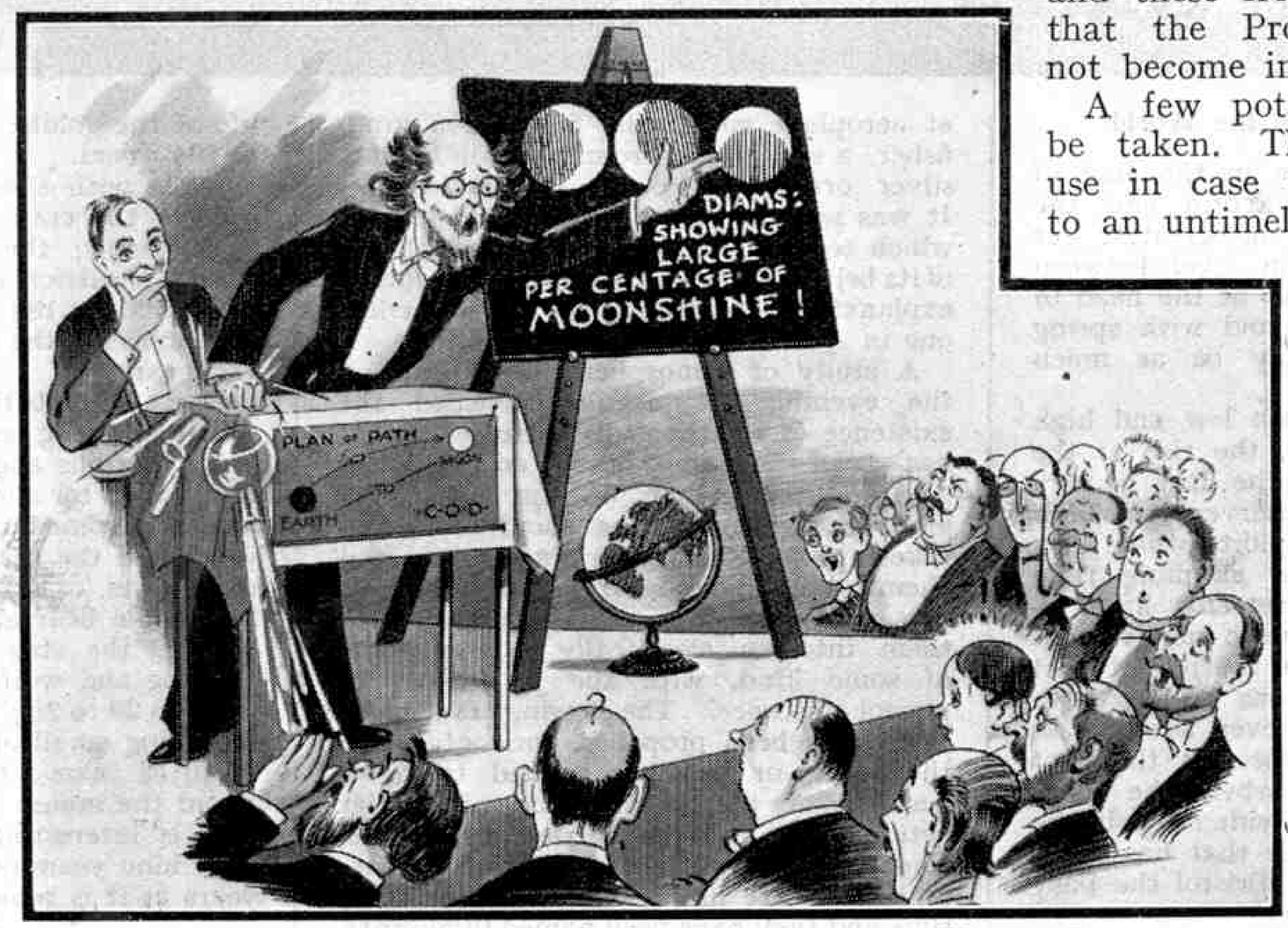
Special Photograph of Secret Trial of a Full-sized Model

The initial velocity necessary to start the rocket on its journey is to be obtained by firing it from a gun of colossal dimensions. The gun will be made by lining

the shaft of a coal-mine with sheets of a new steel alloy of high melting point discovered by the Professor some years ago. The explosive to be used is also an invention of his own. Its basis is liquid oxygen and a refrigerating plant on a large scale will be established at the bottom of the shaft.

In order to maintain its speed the vessel carries in its rearmost compartment a series of what might be described as miniature rockets each containing in a highly compressed state an explosive charge of enormous power. These explosive rockets will be fired out of the stern of the vessel at pre-determined intervals and the effect of each discharge will be to impart new velocity to the vessel.

Several eminent men who have designed rockets to reach the Moon have expressed anxiety regarding the possibility of their rockets striking the Moon with such violence as to break the windows—a very serious matter indeed, so far away from the nearest plumber! Professor Barmidotti's method of preventing this is an absolute triumph of scientific simplicity.



Professor Barmidotti delivering his impressive lecture: "How to Reach the Moon—by one who is going there"

"There is no doubt," says the great man, "that there is an atmosphere of some kind on the Moon. It may be of extreme tenuity, but after prolonged calculation I have thoroughly satisfied myself that its density cannot possibly be less than nothing. I propose, therefore, to pump most of the air in the rocket into a small cylinder while I am still several hundred miles above the surface of the Moon, and to get rid of the remainder of the air by the very simple process of opening a window. I myself shall wear a respirator, of course. The rocket thus will contain a vacuum and therefore it will fall into the lunar atmosphere just as a hollow rubber ball falls into the sea. It will then be easy to control the landing operations by the aid of the propeller and the planes fitted on each side of the rocket."

On perusing the illustration on page 34, intelligent readers will notice that the compartment next to the one containing the explosive bears a striking resemblance to a terrestrial hothouse. This is another feature of which the Professor is justifiably proud. We give the explanation in his own eloquent words:—

"When a human being is confined in a small space the air becomes vitiated by the abstraction of oxygen and the substitution for it of carbonic acid gas. The usual method of purification involves carrying absorbents for the carbonic acid gas, and bulky cylinders containing oxygen pumped in under high pressure. This method is crude, and I have devised a beautiful substitute. It is well known that plants behave in exactly the opposite manner to human beings—that is they inhale carbon dioxide and exhale oxygen. The whole of the air in the rocket will be continuously pumped through an atmosphere containing a large selection of plants and thus it will emerge revivified with oxygen and ready to be breathed again."

The plants to be taken are of a new and wonderful variety that the Professor has produced after years of strenuous research and experiment. They have large and numerous leaves that are ideal for absorbing carbon dioxide and giving out oxygen. In addition, they produce tomatoes on the stem and potatoes at the root, and these fresh foods will ensure that the Professor's health will not become impaired.

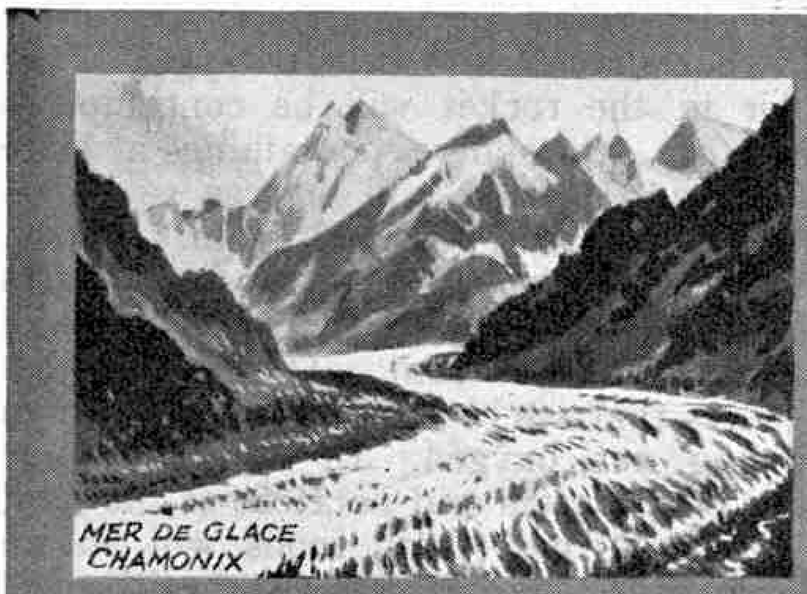
A few pots of lilies also will be taken. The lilies will be of use in case the Professor comes to an untimely end.

As will be readily seen from this brief description, the Professor has anticipated every possibility and three others. Even the serious problem of what will happen if the rocket misses the Moon has been reckoned with, although it is scarcely possible for the plan to end in this way, as all calculations have been carried out to the twenty-first place of decimals.

The Professor explained that the speed of the rocket will take it to the Moon in a week. If by any chance the rocket does not strike the Moon it will simply travel on, and at the end of another week will meet the Earth again! It must be remembered that the Earth and the Moon rotate round each other once a month and that the Earth will therefore be at the opposite side of the Moon a fortnight after the rocket is despatched on the journey. The Professor will then set off once more and he will not miss the Moon a second time.

Professor Barmidotti has already carried out several trial trips with a full-sized model of his rocket-airship, not provided, of course, with the propelling explosive, the oxygen-producing plants and certain other matters. The accompanying illustration shows this airship in one of its flights and indicates plainly that it is perfectly adapted to its task. All that now remains to be done is to construct the real rocket and the gun from which it is to be fired. It is our earnest hope that this article will induce some wealthy individual who is interested in exploration to come forward with the necessary funds.

The Professor is willing to take a passenger with him. The latter would be able to give valuable assistance by taking watch while the Professor rests—and in any case there are more lilies than the Professor really needs. He suggests, therefore, that the individual who produces the necessary funds shall be given the honour of being the first human being to set foot on the Moon.



Our Wonderful World

The Greatest Tide in the World

The range of the tide in the Bay of Fundy, between Nova Scotia and the American mainland, is the greatest yet found. The difference in level between low water and high water at the head of the Bay averages 44 ft. and with spring tides this difference may be as much as 50 ft.

As the interval between low and high water is only six hours, the rise of the water on the shores of the Bay is very rapid, and in fact some observers have been so impressed by its rapidity that they have estimated the rise at more than 100 ft. Accurate measurements have reduced this enormous figure to more reasonable proportions. As a matter of fact there are very few regions of the earth where the tidal range is even as much as 20 ft. Included among these is the west coast of Great Britain, where the range averages 33 ft. It is the wide range in the tidal levels on that coast that has made Liverpool, Glasgow, and Bristol the busy ports that they are to-day.

The cause of the great range of the tide in the Bay of Fundy is mainly to be found in its shape. At its mouth it has a width of 87 miles and a depth of 280 ft., while 110 miles further north its width has decreased to 30 miles and its depth to 130 ft. At this point the bay forks and the contraction in the two branches is even more marked. The energy of the moving mass of water is, therefore, confined within a very small volume, and this cooping up of the tidal wave necessarily involves its rise to a greater height.

One amusing instance of the impression made on former observers by the high tides in the Bay of Fundy is the story of how the pigs of that neighbourhood watch the tides. The story was published in all seriousness in an encyclopædia of 60 years ago. It is said that before venturing on the ground left dry by the retreating tide pigs feeding on the shores posted a sentry on a convenient high point. On the approach of the tidal wave the sentry squealed a warning signal, whereupon the herd ran to safer quarters! We cannot vouch for the truth of this remarkable story, but if true it reflects more credit on the intelligence of the pig than is usually allowed.

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Unexplained Glow in Atmosphere

A considerable amount of interest has been aroused recently by a strange sight that was seen by several people in the south of England. This was the appearance in the sky of a blue flash, which has been variously described as presenting the appearance of a pearly-blue object travelling at aeroplane speed, the flight of a kingfisher, a star from a roman candle, and a silver ornament from a Christmas tree. It was seen about an hour before sunset, which seems to be against the possibility of its being a meteor, and the most probable explanation appears to be an electrical one in spite of the absence of noise.

A study of atmospheric conditions on the evening in question revealed the existence of electrical disturbances and it has been suggested that an electrical discharge somewhat of the nature of globular lightning on a small scale had taken place. This may have produced chemical compounds from the elements present in the air, or have transformed them into an electrically excited state of some kind, with the production of phosphorescence. The glowing mass might then have been propelled horizontally by the wind, or possibly seemed to move because of the continuance of similar action along a layer of the atmosphere. The existence of electrical disturbances of this nature has been known for some time and they have been named fulgurants. Very little further is known about them, as they occur too rarely to be studied easily and they appear without the slightest warning.

Another example of electrical discharge is the well-known "St. Elmo's Fire," the glow sometimes seen round a point attached to an electrically charged body. If the electrical pressure is not so great as to produce a spark, leakage from the point may take place, producing a dull bluish glow that is easily visible in darkness. It has often been seen at the mastheads of sailing ships, and was observed on one occasion to issue from the spear points of Roman legionaries, greatly to their terror. Leakage from a human body has been known to take place by way of the hair in the absence of an easier path. This has the curious effect of making the hair stand on end, as the individual hairs are charged with the same kind of electricity and therefore repel each other.

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Animals that Live 300 Years

There is great variety in the average length of life of various wild animals, assuming, of course, that they die a natural death. Even after careful and prolonged study of the question, it is impossible to say why many animals reach a great age while others fail to do so. Size does not seem to have any influence, for the two creatures that reach the greatest age are the elephant and the tortoise, which may live to be 200 and 300 years respectively. Some birds, including the wild goose, eider duck, raven and parrot, may live as long as 300 years, while the average life of the golden eagle, the king of birds, is 104 years.

Birds with shorter expectations of life include the crane, which may live to 40 or 50 years; the heron 60; the owl 68; the dove, ostrich and woodpecker 60 to 70; the blackbird 18; and the canary up to 24.

Among fish the carp and pike may reach 150 years.

Large animals that cannot expect to live nearly so long as the elephant are the hippopotamus and the rhinoceros, each of which lives for about 40 years. The horse, ass and dromedary may live for 40 to 50 years and the life of a sheep may extend to 15 years. Of other animals the probable life of the bear and of the crocodile is 40 years; the stag 30; the reindeer 16; the dog and wolf 10 to 15; the fox 10; the lion 20 to 25; and the tiger 20.

Among small animals the squirrel lives 10 to 12 years; the hare 7 to 8; the rat 3 and the mouse 3 to 4.

It is interesting to learn that the cat lives nine years on the average—as many years as it is reputed to have lives!

* * * *

No Accounting for Taste

Foods that are repulsive to us are regarded as great delicacies in other lands. M'Clintock, the Arctic explorer, found it necessary on one occasion to pretend to be extremely disappointed when his hosts in the Sandwich Islands informed him that puppy was so scarce that they had been unable to obtain any and could only entertain him with sucking pig instead! Kane, another Arctic explorer, did not discourage rats on his ship because he thought they might prove useful in emergency, and he himself quite enjoyed a good rat for supper. His cook was accustomed to shoot them with a bow and arrow and cook them while fresh. Kane's companions could not bring themselves to follow his example, and as the ship swarmed with rats he had therefore an abundant supply of fresh meat, his only rival in this respect being a captured Arctic fox. It is noteworthy that Kane attributed his comparative immunity from scurvy to his strange diet.

Ants, cooked or uncooked, are greedily eaten in Uganda, a proceeding that would be regarded with horror in this country. The flying ants of Uganda emerge from the great red earthen ant heaps at dusk at certain seasons of the year, and immediately everybody runs to catch the insects, either in their hands or in the folds of their clothes spread over the heap. Even the chickens run! Some of the natives tear the wings off and eat the ants raw, but many prefer them cooked, when they form a greatly prized luxury. Even Europeans have grown to like them on account of their sweetness.

The End of Niagara Falls

The impressiveness of Niagara Falls is not due to their height. On the American side they are only 164 ft. in height, and this seems small in comparison with the 822 ft. of the Kaieteur Falls in British Guiana, the 1,500 ft. of the Yosemite Fall, or the 2,000 ft. of the Keelfos Fall in Norway. But in none of these cases is the effect on the onlooker so great as with Niagara.

This is due to the enormous volume of water that pours over the brink of the famous cataract, the name of which is an Indian word meaning "thunder of waters." The river above is a mile in width and behind it an enormous reservoir of water is stored up in Lakes Superior, Michigan, Huron and Erie. A quarter of a million cubic feet flow over the Falls every second but as the total surface of the water in the lakes is 90,000 square miles in area this amount is comparatively a mere drop.

With such an enormous supply it would seem impossible for the Falls ever to become dry. This has happened temporarily on occasions when the water was frozen, but there is actually a possibility of the Falls becoming dry permanently. The threat to the existence of the mighty spectacle is a slow rise in the rock foundation. Water from Lake Erie enters the Niagara River at Buffalo, the well-known American city on the eastern shore of Lake Erie, 16 miles from the Falls, and here the rate at which the rock is rising is six inches per century. This seems an insignificant amount, but it may have far-reaching consequences. It is not absolutely certain, of course, that the rise will continue, but if it does the surface level of the water in Lake Erie will also rise until, in 1,600 years' time, it will have risen to the level of Lake Huron. The flow of water to the Falls from the west will then cease and Niagara will be dry!

Another consequence of this movement is even more startling. The rise in the surface level at one end of the system of the Great Lakes will no doubt alter their shape considerably, but it will also result in the ever-flowing waters seeking a fresh outlet. The water now flows over the Niagara Falls because there the lowest channel through the high land around the Lakes is found. The next highest is at the southern end of Lake Michigan, and if the water finds an outlet here it will link up with streams that form a portion of the great Mississippi system. A glance at the map shows that within a mile or two of the southern shore of Lake Michigan there are streams that flow southward to the Ohio River and it will be realised that a comparatively small rise in the level of the water of the Lakes will lead to an overflow in that direction.

Thus the changes will be enormous. The map of North America in the year 3530 A.D. will show Lake Ontario diminished greatly in size or represented by a mere trickle. The St. Lawrence will be fed only from the Ottawa river and a few other small streams, and will certainly have lost much of its importance. The Mississippi, on the other hand, will be swollen by the overflow of the four largest of the Great Lakes and will justify still more emphatically its Indian name of "The Father of Waters."

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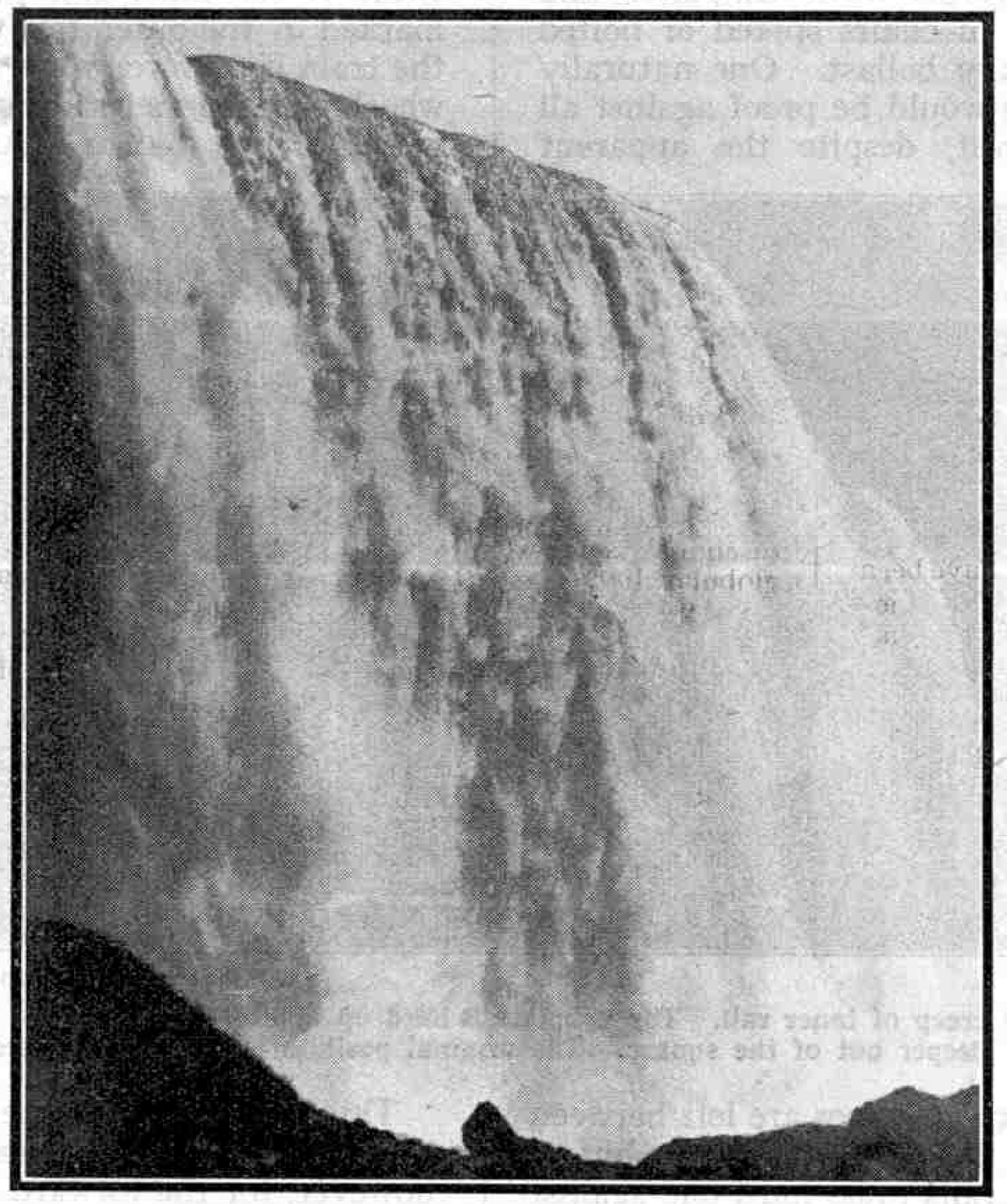
Tiny Fish Helps to Fight Malaria

A fish less than an inch in length promises to become of great importance in medical science. This is an American fish known technically by the name "*Gambusia*." It was introduced to Spain in 1922 and from there specimens were taken to Italy and released in the drainage canals of Ostia and Fiumicino at the mouth of the Tiber. The fish adapted itself quickly to its new conditions and thrived in a manner that suggests that the natural enemies with which it has to contend in America do not exist in Italy.

The great value of *Gambusia* lies in the fact that its favourite food is the larvæ of the malaria-carrying mosquito. This insect lays its eggs on the surface of the water in marshy districts, and the larvæ that develop move about with a peculiar jerky motion. The tiny fishes devour these larvæ with great avidity, and they have proved themselves capable of accounting for from 80 to 90 per cent. of the larvæ in the streams that they inhabit.

The provision of adequate drainage and the destruction of mosquitoes are the first steps that must be taken in order to clean up any district in which malaria is prevalent. On the basis of the experiments carried out in Italy it seems that the *Gambusia*, provided it can adapt itself to the type of water in the district, is capable of accomplishing the second of these tasks without difficulty.



A fine photograph of the wonderful Niagara Falls

Where Did the Moon Come From?

The influence of the Moon and Earth upon each other is far more important than is usually supposed. Both have been used as clocks for thousands of years, the Earth giving the measure of the day by its time of rotation and the Moon the measure of the month by the time it requires to complete its circuit round the Earth. For all practical purposes the Earth is quite a good clock, but a close examination of its past history reveals the astonishing fact that it is slowing down!

The Moon, acting through the tides, is the cause of this retardation. The water of the ocean is kept in constant movement by the attraction of the Moon in conjunction with the rotation of the Earth, and the constant friction between the moving particles of water and the bottom of the sea acts as a brake on the speed of the Earth's rotation. The greater part of this braking effect is due to shallow seas such as the Bering, Yellow and Irish Seas, for the movement of the water at the bottom of the deeper seas is comparatively small and consequently has little effect.

The attraction between the Moon and the ocean is mutual, and braking the mass of tidal water has the effect of slowing down the Moon. In consequence of this the Moon is very slowly receding from the Earth.

The effect of these forces is, of course, very small. The day, for instance, is only growing longer at the rate of about one-thousandth of a second in a century, so that it will be somewhere about a million years before another minute is added to the day.

If the Moon is moving further away from the Earth, however slowly, it obviously must have been closer in the past than it is now. The tides would then be greater and the frictional effect on the Earth greater also. When the Moon was at half its present distance its tidal effect would be 64 times as great as at present, and if it ever were close enough to almost touch the Earth it then would have produced a tidal effect more than a million times greater than that produced to-day.

At that time the day would be only four hours in length and its duration would be changing far more rapidly than at present. It has been calculated that a planet such as the Earth would most probably break up when spinning at such a rate, just in the same manner as a grindstone or the flywheel of an engine will burst if rotated too rapidly. On this supposition the suggestion has been made that such a break-up actually occurred and that the Moon is one of the fragments. In that case the Moon would commence its career as a satellite by rotating around the Earth and almost touching it. If the Moon did actually originate in this manner the gap left by it when it broke away is probably the great chasm now filled by the Pacific Ocean. Support is given to this idea by the fact that the material of the Moon seems to be similar to that of the Earth's outer layers.

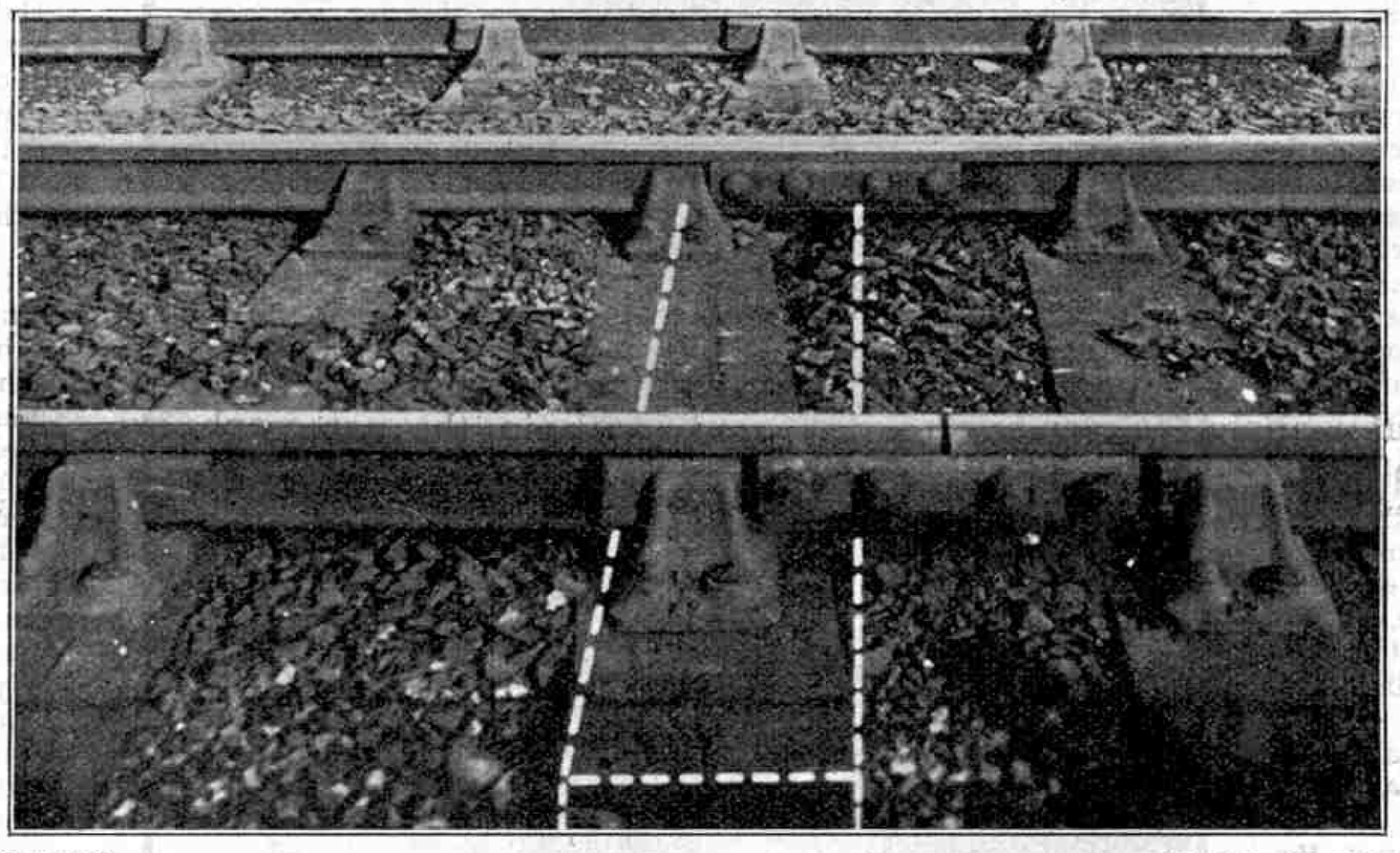
The Mystery of Creeping Rails

By J. Kingsley Bell, C.E.

MAIN line rails weigh about 95 lb. per yard, and are tightly connected together with fishplates and bolts and firmly held in chairs spiked or bolted to sleepers embedded in heavy ballast. One naturally would expect that such rails would be proof against all kinds of movement, and yet, despite the apparent solidity of the permanent way, they travel slowly but surely from the positions in which they were originally laid. This movement is termed "creeping."

The question immediately arises: "Why should these heavy rails move, and what makes them do so?"

An obvious answer would be the effect of heat upon them. It is well known that, under a hot summer sun, the rails expand or in other words increase in length. Spaces are left between the ends specially to allow for this expansion, but if this space is insufficient the rails press hard one against the other and either thrust one another along or—a danger against which the permanent way inspector has always to be on guard during hot weather—they "hunch up" at the joints.



Courtesy] [*L.M.S. Magazine*

Showing creep of inner rail. The fishplate is hard up against the chair and has pushed the sleeper out of the square. The original position is shown by dotted lines

This explanation of creeping does not suffice, however. It accounts for one aspect only of the case; for even in winter the creeping does not cease and the rails continue to travel, while rails that are out of use are not subject to the trouble at all, thus demonstrating that hot weather is not the primary cause of the trouble, but at most only an auxiliary. Obviously the solution of the problem is not quite so easy as it appears to be at first sight. The problem becomes even more obscure when it is observed that, not only do the inside and outside rails of the permanent way creep at different speeds, but in some circumstances they actually travel in opposite directions—one rail creeping in the direction of the traffic and the other away from it!

This peculiar tendency is due to the motion of trains when rounding curves. In rounding a curve, although theoretically it should not do so, a train travels by means of a series of rapidly succeeding lateral jerks, which tend to thrust the rails on the outside of the curve forward and those of the inner side backward. The effect is more marked in the outer rails because the general motion of the train is onward, while the thrusting backward of the wheels on the inner rails is merely incidental to it. It is probable also that on sharp curves the leading guiding wheel presses heavily on the outer rail and accentuates the forward thrust. Hence the inner rails travel backward at a slower rate than the outer rails move forward. The creeping effect on both sets of rails is intensified in proportion to the speed and number of trains passing round the curve, and ultimately it extends into the straight portions of the road at each extremity of the curve.

This explanation of the cause of "creep" in opposite directions on the same track at curves does not account, however, for the forward movement of both rails in the straight, a feature that is particularly noticeable at points where the road bed is composed of yielding material and on tracks approaching busy stations. In these two special sets of circumstances, "creep" is set up by two distinctly different causes.

In the former case, a yielding road-bed, the theory advanced is intensely interesting and is best explained by reference to the accompanying diagram. Here we show, in a slightly exaggerated form, the effect on a rail as a carriage wheel passes over it. The section A to B gives slightly under the pressure of the wheel and it will be easily understood that the more yielding the road bed and the heavier the load borne by the wheel, the greater will be the tendency of the rail to bend under the pressure. The effect then is somewhat similar to that attained when rolling out a piece of dough. As the roller passes along, it will be noticed that immediately in front there is a wave that the roller seems to push ahead of it until the end of the dough is reached. In the same way, the wheel passes along the rail in what is, in effect, the trough of a shallow wave, continuously striving and failing to climb to the crest and pushing ahead of it the forward side. Experiments have proved

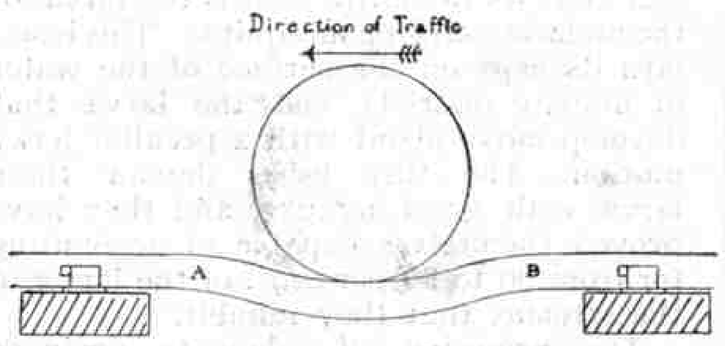
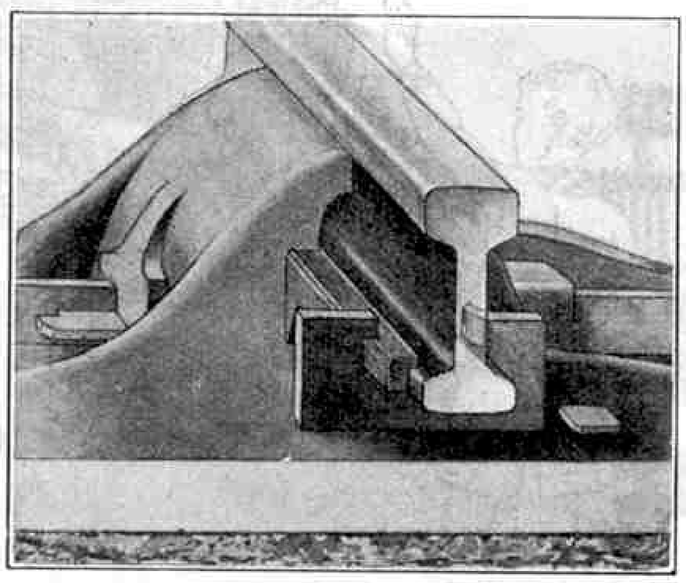


Diagram to illustrate "wave" theory of creeping

that this curious phenomenon actually does take place.

At an earlier point in the explanation of this theory, we stated that the heavier the wheel load the greater the effect on the "wave." In actual fact this curious "railway disease," like many illnesses of mankind, may be said to be due entirely to the march of civilisation, with its attendant effect on railway practice. Forty years ago, "creep" was unknown and its existence to-day is directly attributable to the increased weight of railway loads per axle.

We have now examined three different causes of "creep" but the special cause of its more noticeable presence on the lines approaching a station has yet to be dealt with. This form is probably the easiest to explain. It is due simply to the application of brakes as a train commences to pull up on approaching the station. The retarded wheels tend to skid and drag the rails with them. A simple illustration of this theory can be obtained by any reader possessing a bicycle. Lay a plank of wood at a convenient spot and, when on the bicycle, ride at a fair speed to mount the plank lengthways. As soon as both wheels are on the plank, apply the rear brake hard and the plank will move forward very slightly, due to the thrust of the locked wheel. Just a word of warning—the suggested experiment is not unattended by slight risks to both rider and machine.

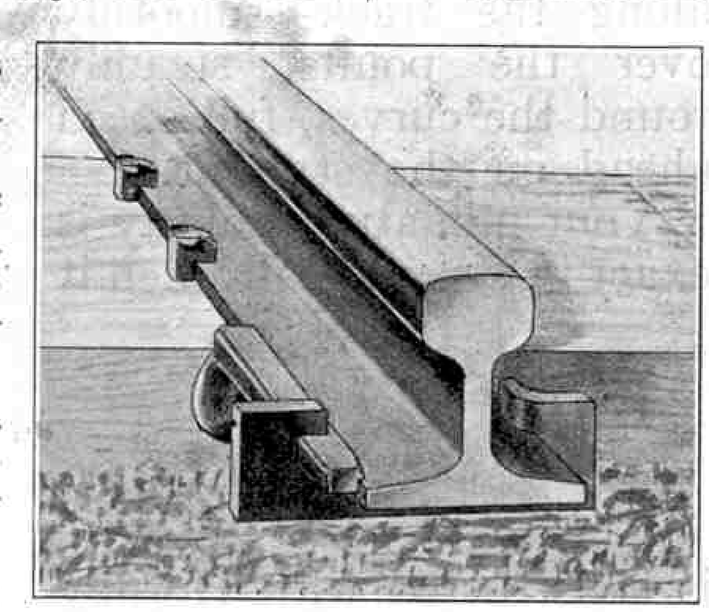


Bull-head rail in chair

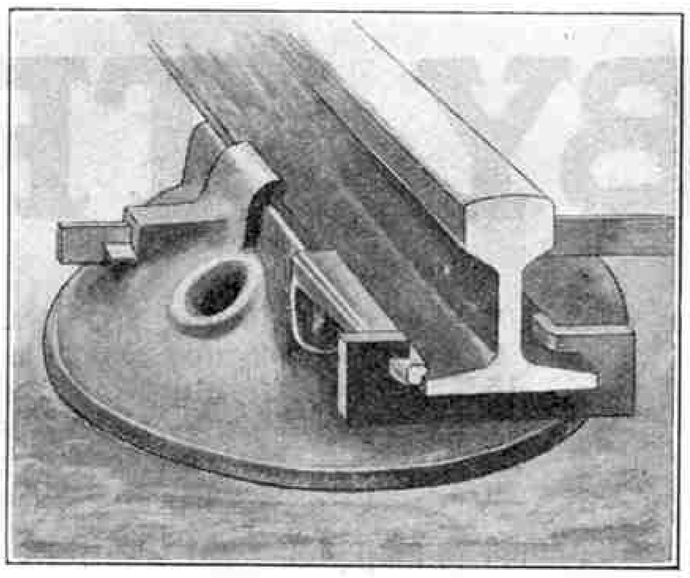
There is yet another interesting cause of "creep" and this particular cause, in combination with the "waves" mentioned above, can create some extremely bad effects. The steady "rap rap" sound produced by the passage of a wheel bogie over a rail joint is familiar to all travellers but few know actually what is taking place, or that the "rap" is produced by the blow struck against the end of the rail next to be traversed by the wheel, as it crosses the expansion joint. Each individual blow plays its part in driving the rail forward.

Rail creep, if combined with expansion sufficient to close up the joints, exerts almost unbelievable force, and if the first symptoms are seriously neglected the rails are gradually forced out of position and the sleepers and points, despite their weight, become dangerously distorted. The illustration on page 38 demonstrates this fact very clearly. In this it will be seen that the movement of the rail has forced the fishplate hard on to the rail chair and pushed the sleeper several inches forward.

In such cases the whole road must, of course, be re-adjusted. If the permanent way is properly maintained, however, and no abnormal circumstances prevail, creeping is not a serious factor, and in this country it seldom amounts to more than 6 in. a year, although in places abroad, where the track is not so solidly constructed and the rails are lighter in weight, there are known cases of rails having crept 2 ft. with the passage of each train!



Flat-bottom rail spiked to sleeper



Flat-bottom rail in pot sleeper

The above illustrations, reproduced by courtesy of the Improved Rail Anchor Co. Ltd., show the Rail Anchor applied to various forms of rails and chairs

Obviously the trouble must be countered at the earliest possible moment. First the keys are knocked away from the rail at which the creep has started. Then the bolts are removed from that side of the rail connecting it to the succeeding rail. The first rail is then levered back into its true position by means of a long crowbar. The remaining rails affected are treated in a similar way, and the fishplates bolted back into position after allowing the proper expansion spaces. In certain circumstances several rails may be moved back together instead of correcting each singly.

After reading of this curious mystery of the railroad, doubtless our readers will be speculating as to whether the same trouble arises with that other well-known form of permanent way, the tramway track. It does, but only in a very minor degree.

The method of laying tramway tracks accounts for the comparative immunity. The paving surrounding the rails serves as an anchor. Also, the system of welding the joints eliminates entirely any forward thrust due to blows at the rail joints, as dealt with in the paragraph explaining the wave theory.

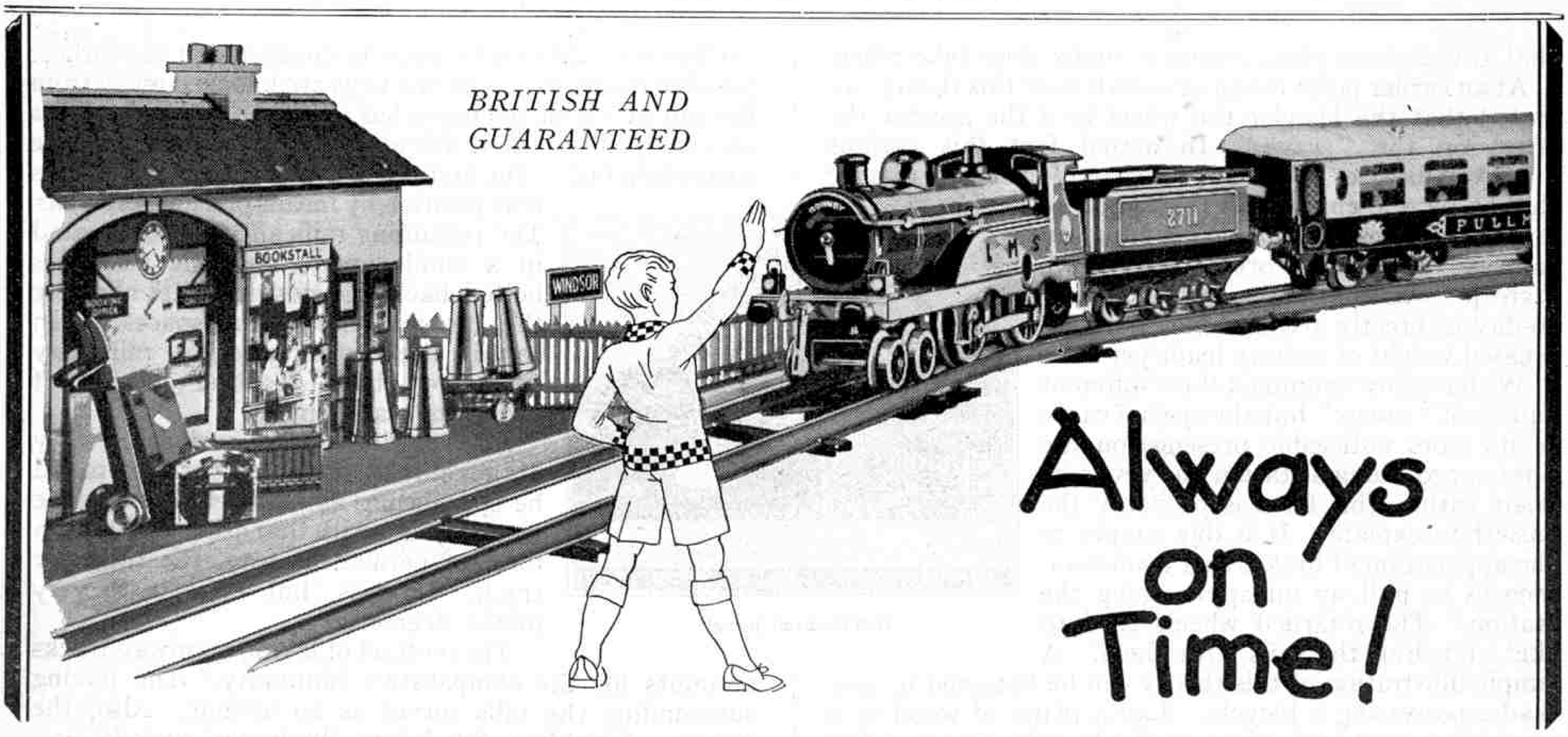
Mention of the wave theory, however, brings us to what is, in effect, the only manifestation of the tendency to creep that appears on a tram track. Curious horizontal markings successively light and dark, in colour somewhat akin to the shades on the back of a mackerel, are observable on the flat surfaces of tram tracks. This phenomenon is due to "corrugation" of the rail surface and may be attributed to the frustrated attempts of the rails to creep. Fortunately for the tracks, the disease, if such it may be termed, is only a minor ailment and does not call for any extensive remedial measure.

In cases where tramways are laid across open country on enclosed tracks, the rails are laid in the same manner as railway permanent way. In effect such tracks, intended for express tram services, are light railways, and are subject to "creep" in the ordinary manner. From these facts readers will gather that "rail creep" is very largely due to the system adopted in laying the rails.

Several devices known as "rail anchors" are used to minimise "creep," which up to the present has defied attempts to subdue it entirely. Most of these anchors are similar in their essentials and therefore it is only necessary to describe one such device that has given complete satisfaction under tests of some four or five years' duration.

This device consists of two simple parts, the first a rigid taper key or wedge of steel recessed along the inner side so that the upper part of the key body overhangs and bears on the upper surface of the foot of the rail. The key tapers as to its vertical sides from one end to the other, and at its wider end is provided with a

(Continued on page 72)



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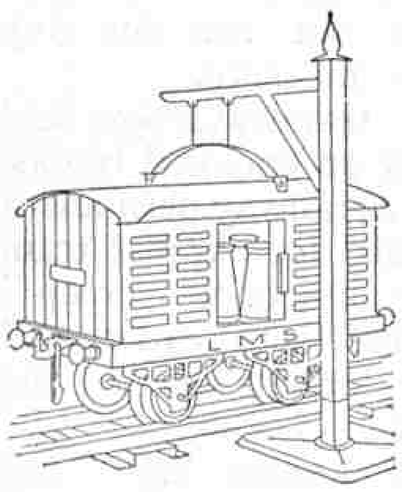

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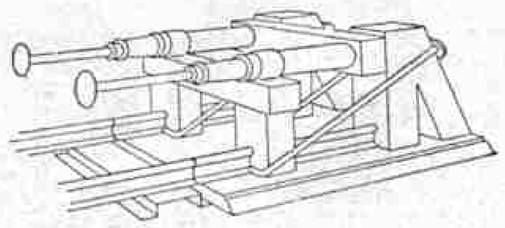

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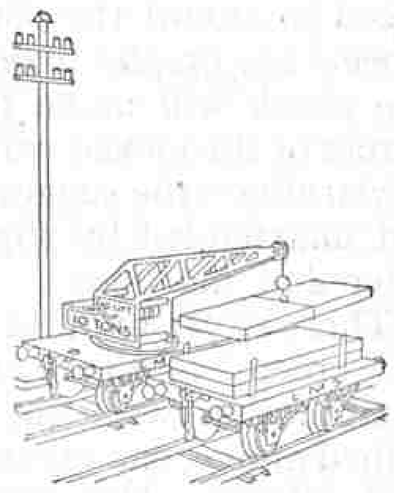

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Miniature Railway Timetable Working

How to Construct a Scheme for Your Layout

By L. H. Turner (Manchester)

NO model railway enthusiast can be said to have secured the greatest possible amount of fun from his railway system unless he has operated it to a timetable. The fascination of timetable working must be experienced to be realised, and it is a great pity that so few model railway owners give serious attention to this part of their hobby. There is no particular difficulty about running a model railway to a timetable once the latter has been prepared, and it is just in regard to this preparation that many readers appear to experience trouble. Actually the method is quite simple and the object of this article is to show how a practical working timetable may be constructed for any layout.

The first step is to make an inventory of all the locomotives, coaches and wagons that are to be employed on the line. Let us suppose this available material to consist of two engines, A and B; three coaches and one passenger guard's van; and four goods wagons and one goods guard's van. This stock must be allocated among the depots attached to the several stations included in the system, but as the layout we are now considering is very simple, we propose to "shed" all our stock at the principal station on our line.

The layout includes three stations, Hornbyville Terminus on the main line; Binns Village, a small wayside halt on a branch line; and Meccanotown, the terminus of the branch line. Both the termini, and the wayside station also, have goods depots. In order to make matters perfectly clear throughout the description, these three stations will be referred to respectively as X, Y and Z.

A start may now be made with the timetable. It is necessary first to examine the traffic requirements for the various periods of the day in order to discover what service is necessary. Then, when all requirements are known, the times of the trains must be fixed and the make-up of the trains arranged. To enable the system to be followed clearly we give two complete tables, the first being the timetable and the second the working schedule. The letters E, C and W refer respectively to engine, coaches and wagons.

It will be seen that the first train to leave Hornbyville is an express for Z, due to leave at 6 a.m. and not stopping at Y. It consists of an engine, three passenger coaches and guard's van. It may be mentioned here that it will be assumed that each train is complete with the appropriate guard's van and therefore no further mention of these vans will be made.

At the completion of this run it is necessary to enter on the working schedule the exact location of the stock in order that the controller of the line may know the precise state of affairs. Thus the first line shows that all our stock is at Hornbyville. The second line, representing the position after the completion of the first run, shows that engine B, one passenger coach and five goods wagons are at X, while engine A and three passenger coaches are at Z.

A certain amount of time will be occupied in reversing engine A and shunting engine B before the next train can start, and it is here that careful adjustment of the timetable is necessary. Ample allowance must be made for the carrying out of the required operations. Four minutes are taken at X in shunting engine B on to the four goods wagons that it is required to haul to Z, departing from X at 7.4 a.m. At the completion of this run the position of the rolling stock again is entered, the object being to make it easy to know whether stock can be drawn upon in an emergency.

In reversing engine A at Z, seven minutes are occupied and then A is despatched with three passenger coaches to Y, this being a local passenger train. As soon as engine A arrives at Y the working schedule again is completed and so on throughout the remainder of the day.

For a small layout the trains may be despatched at intervals of about four minutes but, of course, these intervals will vary according to the length of track available and the number of intermediate stops that are to be made. The hours are placed in front of the minutes simply to make the table appear more realistic. A copy of the timetable is given to each stationmaster, with instructions that trains must be run according to the times set forth in it.

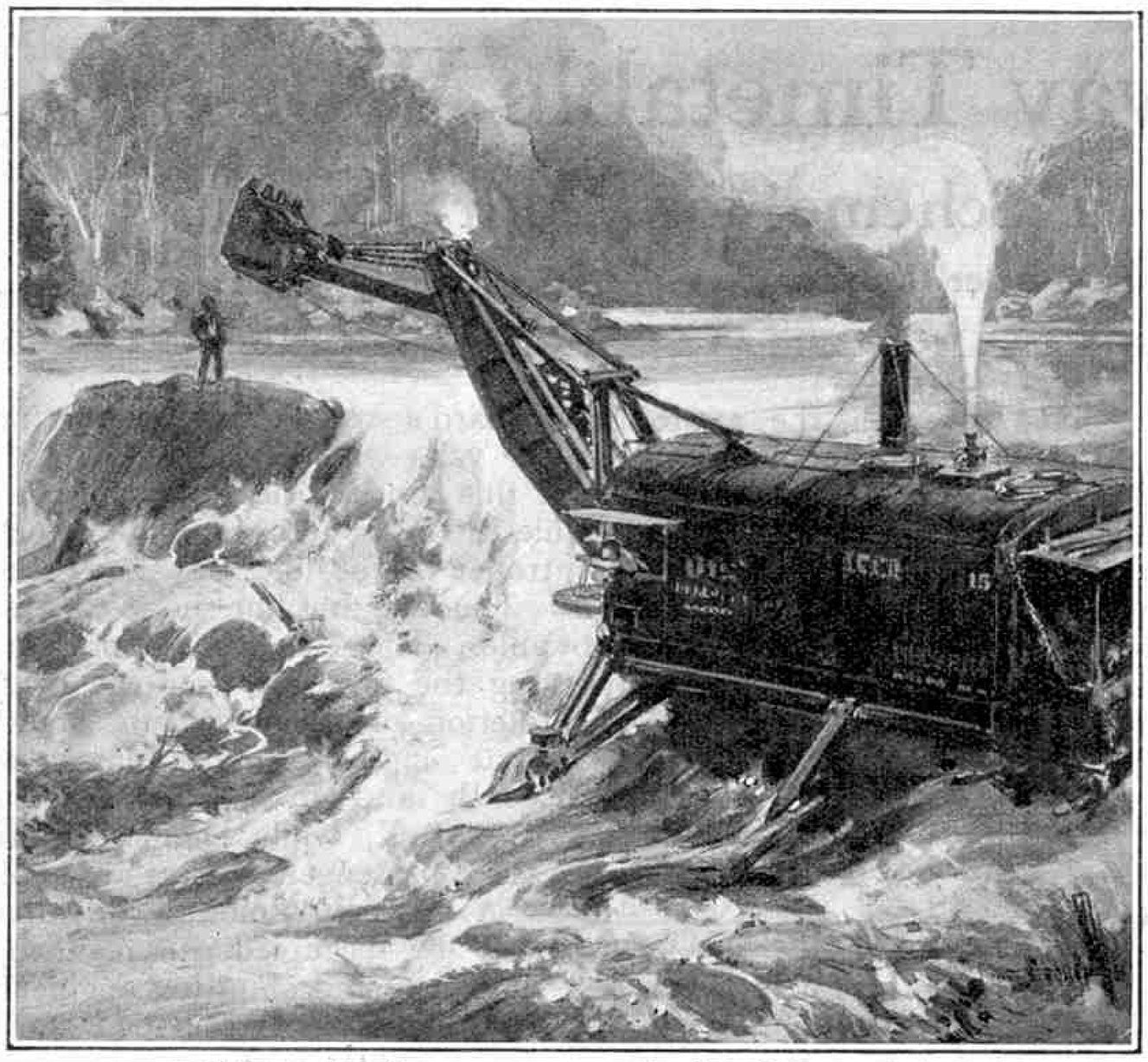
It is quite obvious that the larger and more elaborate the layout, and the greater the number of engines, carriages and wagons available, the more intricate may be the working operations. At the outset, however, the line controller's aim should be to operate a simple scheme with accuracy and precision, adding additional services only by degrees as experience is gained. To commence with an intricate timetable generally means erratic and late running of trains and possibly an accident or two; and conditions of this kind quickly result in the line gaining a very undesirable reputation!

TIMETABLE

Train No.	Eng. No.	C	W	To	From	Stop at	Time	Remarks
1	A	3	—	Z	X	—	a.m. 6.0	Exp. Passgr.
2	B	—	4	Z	X	—	7.4	Exp. Goods
3	A	3	—	Y	Z	—	9.7	Local Passgr.
4	A	3	—	X	Y	—	10.11	Local Passgr.
5	B	—	3	Y	Z	—	p.m. 12.14	Local Goods
6	B	—	2	X	Y	—	2.17	Local Goods

LOCATION OF STOCK

Working No.	Hornbyville (X)			Binns Village (Y)			Meccanotown (Z)		
	E	C	W	E	C	W	E	C	W
	A, B	4	5	—	—	—	—	—	—
1	B	1	5	—	—	—	A	3	—
2	—	1	1	—	—	—	A, B	3	4
3	—	1	1	A	3	—	B	—	4
4	A	4	1	—	—	—	B	—	4
5	A	4	1	B	—	3	—	—	1
6	A, B	4	3	—	—	1	—	—	1



Paldi's head and an arm were protruding from a window

PALDI PAYS

An Engineering Story

by

Irving P. Rogers

MURRAY scowled as he edged into the cab of the big steam shovel and saw Tony Paldi busy with the levers that controlled it. At the young Italian's touch the cab swung quickly round with a rumble of gears and rollers ; the steel arm dropped to an easy angle, and the shovel moved forward.

The Italian boy shifted a couple of levers ; the shovel tilted, bit deep into the base of the nearest hill and then ploughed forward away from the cab. Again Paldi's brown arms flew about and, choked with dirt, the shovel moved upward toward the boom. The boom itself lifted, swung slowly round until it was over the small mountain of earth that spanned the ravine above the machine and halted. Then the shovel collapsed and deposited its ton of dirt a yard from where its last load had dropped. Paldi sent the boom and cab swinging round for another load and faced about, smiling.

" How you like dat, hey ? " he asked brightly. He suddenly shrank back as he saw to whom he had spoken. " Oh, I t'ought you Donaldson," he exclaimed.

" You thought wrong," growled Murray. " See here, I'm getting tired of your hanging around this thing all your spare time. Some day you'll get your jacket or pants' leg caught in some of these gears, and we'll have to shut down while we pick the remains of you out of the cogs. Get out—right now ! "

Paldi shut off the power and stepped back. " Donaldson say for me to run da shovel while he go to talk to da boss one meenit," he explained, flattening himself against the wall to let Murray get at the levers.

" Well, I'll take the job off your hands," Murray replied sourly. " This is no time for a greenhorn to be in charge here. You'd better get over on the other side of the hill with the rest of the wops before that dam goes out and you get washed away."

Paldi's dark eyes flashed at the hated word " wops," the name that Murray gave contemptuously to all foreigners, but he backed away obediently and left the cab without replying.

He had scarcely disappeared when Donaldson, the chief engineer, came hurrying in. The big Scotchman's face was full of indignation. " What's the idea of your firing Paldi out of here like that ? " he demanded. " I met him just now, and he looked as if he had been pretty badly treated. What did you say to him ? "

" Nothing much," grunted Murray. " I just told him to keep away from this concern."

" He wouldn't have been here if I hadn't suggested it," Donaldson declared. " It was my fault that he ever looked inside this cab. He was interested in the shovel, and I offered to teach him how to run it. I saw he was bright and felt sure that he could learn the trick, and I wasn't wrong. You know that. He's a better operator right now than you or I."

Murray could not deny it.

" You pay too much attention to these wops," he argued. " You're always trying to do something for them, and it won't do anybody a bit of good. They don't appreciate it. They'll never try to do anything for you."

" You're mistaken," Donaldson replied quietly. " They never forget, and they'll pay me back somehow if I help them. Paldi will pay, just as sure as I'm alive, although I don't ask or care for pay."

" You'll see," Murray grunted.

Donaldson went to the door and stood there, looking out. He came back in a moment.

" Things look bad," he said, consulting his watch. " The creek has risen three inches in the past fifteen minutes. There's a good-sized lake back of that dam, and how much longer she'll hold is mighty uncertain. The men are getting skittish about working on her any longer. They won't work far from the ends, and its up to us to keep the middle above the water."

Murray swung the shovel round and loaded it before he replied.

" Poor judgment anyway, trying to back that creek

up with a pile of dirt," he muttered.

Donaldson turned again to the door and stood thoughtfully staring at the " pile of dirt." The temporary dam would have been all right if unexpected rains had not come. The construction company that employed him was building a steel and concrete bridge across Black River, where Cat Creek intersects it. As the water from the creek had threatened to make the foundation work of the bridge difficult, the steam shovel had been set in the creek bed, and the temporary dam had been started. The plan had been to hold back the water of the creek until the concrete abutments for the bridge could be completed. In ordinary circumstances the dam was more than high enough and strong enough, but a two days' downpour had made a veritable river of the little stream. Donaldson frowned at the dam, where the men were at work on either end, and then re-entered the cab.

" I'm going up to take a look at things," he said. " The boss wants us to keep at work here as long as it isn't too risky, but he said for us to abandon the shovel at the first sign of the dam's going out. And when we see that it won't hold any longer we're to whistle, so the men at work about the bridge can get in the clear. If anything happens while I'm gone, tie the whistle cord down and run for the hill."

Murray nodded shortly, and Paldi, who had followed the chief engineer back to the big machine that so fascinated him, looked at Donaldson questioningly. The engineer smiled. " Better not bother Murray," he said, laying a hand on the dark-skinned lad's shoulder. Then he hurried away.

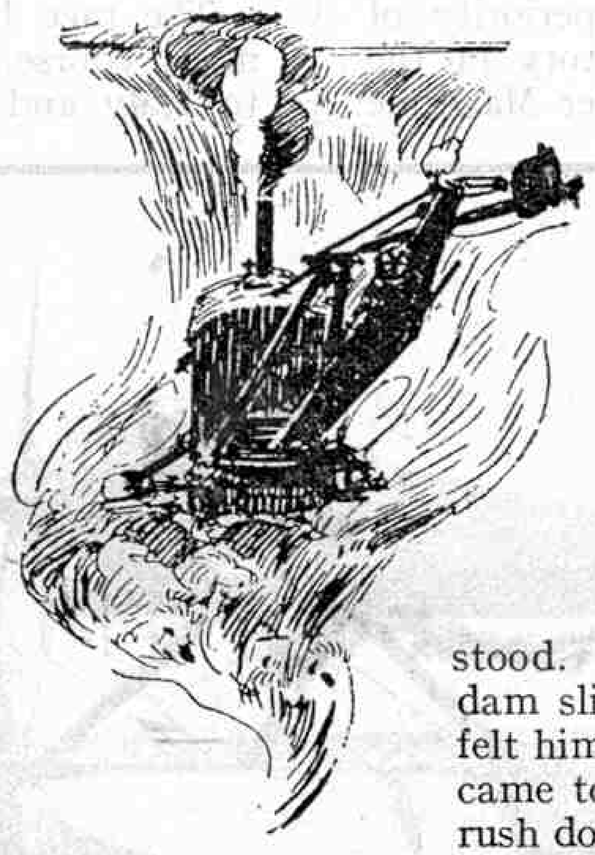
Stopping in the doorway, Paldi watched his friend cross the old creek bed and climb to one end of the dam ; he saw him pass the workmen busy there and then walk out to the centre of the wall of dirt. Paldi still glowed with the warmth of Donaldson's manner, and now he felt as never before the worth of the chief engineer's interest. It had been almost everything to him, a lonely fellow who wanted to be something more than an ordinary labourer. He wanted to do work that was difficult and important, and Donaldson, understanding, had taught him to handle the big shovel, teaching him patiently during Paldi's hours off duty. Yes, Donaldson had been good to him, and some day he, Paldi, would show that he hadn't forgotten.

Donaldson was standing on the centre of the dam, directing the work of the shovel, and Murray was intent on following his signals. Paldi watched both the engineer and the shovel, but he found time also to scan the face of the dam from time to time. Suddenly he gave a sharp cry and stood transfixed. About half-way up the dirt wall a ragged black line had spread from hill to hill.

Murray, hearing Paldi's cry, looked around. When he saw the young Italian's pointing finger and followed the direction it indicated, he sprang away from the battery of levers and, dashing past the Italian, fled toward the nearest hillside.

Paldi sprang to the place that Murray had vacated and seizing the whistle cord, jerked it taut and tied it to a near-by ringbolt. The machine shrieked like a demon. The workmen on the dam fled headlong toward the hillsides, and not a minute too soon. The whole dam seemed suddenly to slump upstream and settle. Water poured over all its crest except the slightly higher part where Donaldson was standing. The entire dam would collapse in a moment. The engineer seemed alive to his danger, but was powerless to help himself.

Though Paldi realised his own danger, he felt fear only for the big fellow who had been kind to him. For a moment he stood helpless and his breath came fast ; then he reached for a familiar lever and drew it back.



Donaldson, feeling the dam topple and seeing the water pouring over on either side of him, thought his last hour had come. There seemed no way for him to escape. He thought of plunging down the face of the dam, but he realised that the whole dirt structure would sweep away before he could run to safety.

He had given up hope when suddenly the arm of the shovel jerked violently and then swept toward him. He saw it stop above him, saw the shovel drop downward within reach at his side. He glanced at the cab. Paldi's head and an arm were protruding from the window, and his arm was gesticulating violently. Donaldson understood. He leaped aboard the shovel even as the dam slid with a shudder from beneath him. He felt himself jerked high into the air, and as the arm came to rest he saw the yellow flood beneath him rush down upon the steam shovel and engulf it.

The arm trembled violently, but he knew that he was safe ; the shovel was too well anchored to be overturned or torn from its moorings, even by such a terrible rush of water.

But what of Paldi ?

It only took a few minutes for the pent-up water to get away, and by that time Donaldson had swung over the shovel to the arm and down the steel trusswork to the cab. He wrenched open the door and sprang inside. Paldi lay unconscious on the floor, but when Donaldson, with a great fear, slid his hand inside the boy's shirt he found his heart still faintly beating. He took the young Italian in his arms and ran with him through the muddy water to the nearest hillside, where willing hands helped to bring back respiration.

Within half an hour Paldi was breathing regularly again, and not long afterward he was able to tell how he had escaped what had seemed certain drowning.

" I t'ink it all over with me when I see da dam go out," he said, " an' I just grab da levers an' wait. Then da water hit da cab. Da winda an' da door both slam shut, an' most of da water go by. A lot poured in where da tackle go out, though, an' da cab fill pretty fast. I climb up an' up till I reach da roof ; then I swallow 'bout a barrel of water, an' I don't know anyt'ing anymore."

Donaldson caught the boy's hand. " It was a mighty nervy thing to do, Paldi," he said huskily. " But, my boy, you shouldn't have taken such a risk for me."

Paldi's dark eyes grew soft. " You been good to Paldi," he replied. " I been wantin' to pay you back. I thought dis a chance to pay a leetle." He closed his eyes, then opened them again, smiling. " Maybe you let me run da shovel some now ? "

" You may run it all the time ! " declared Donaldson. " Murray is through ! You just lie low to-day, and to-morrow the old shovel will be waiting for you."

Paldi nodded brightly and closed his eyes again.

The Schneider Trophy

Britain's Greatest Air Success

NOTHING greater has been done since the earliest days of aviation to establish the superiority of British aircraft design than the victory in the international seaplane race for the Schneider Maritime Trophy held at Venice in September last. Not only did the winning Supermarine - Napier S5 monoplane reach a speed 35 m.p.h. faster than anything previously recorded in the race, but it broke all the existing world's speed records for any type of machine. In addition, the second Supermarine machine and the Gloster-Napier biplane that retired in the sixth lap each averaged 7 m.p.h. faster than the Italians' fastest lap! A remarkable feat, beyond all question.

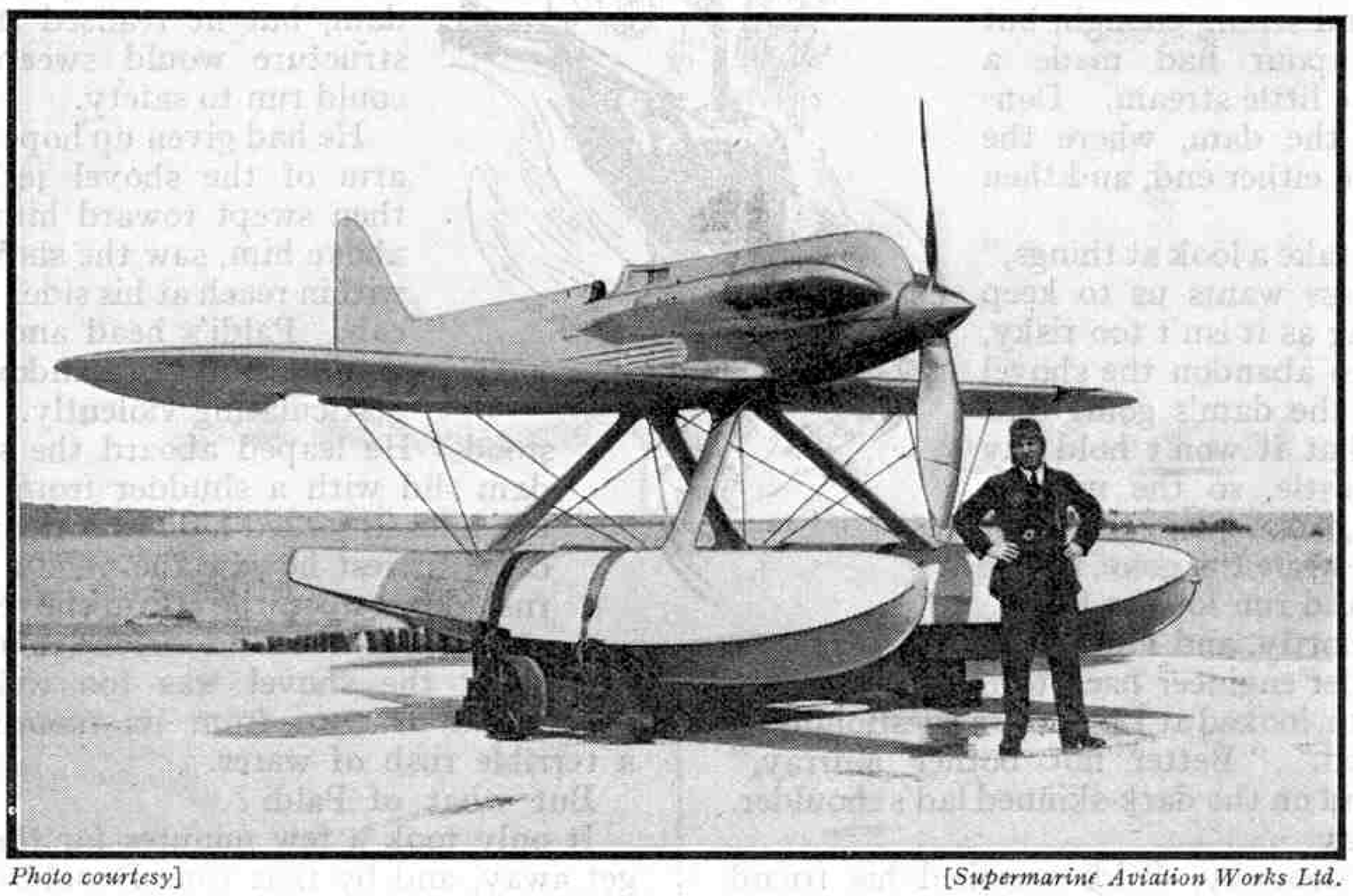


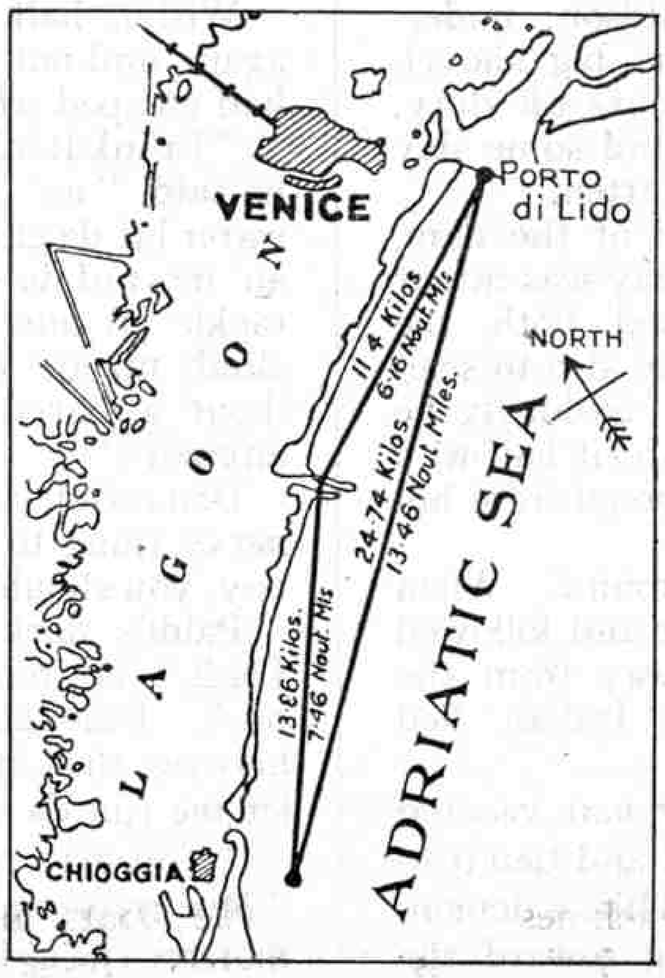
Photo courtesy] [*Supermarine Aviation Works Ltd.*

Flight Lieut. S. N. Webster, A.F.C., standing beside the Supermarine-Napier "S5" in which he scored a fine victory for Britain. His average speed for the 217 mile course was 281.54 m.p.h.

In considering these performances from the point of view of pure speed, regard must be had to the triangular course over which the Schneider race is flown. The sharpness of the turns compels the machines to approach and turn considerably below their maximum speeds. Over a straight course it is probable that the Supermarine machines would easily exceed 300 m.p.h. as against the previous straight 3 km. course speed record of 278 m.p.h. that was established by a French land type machine. On a similar straight course it is probable that the Gloster machine also would come close to the 300 m.p.h. mark.

It should be explained at this stage that the race is not a mere test of speed, but that M. Jacques Schneider, a French manufacturer who presented the Trophy in 1913, stipulated that before taking part in the actual race each machine must prove its seaworthiness, and for that purpose a series of tests, including take-off, landing and mooring capacity, is held. Thus it is ensured that every machine taking part is capable of performing a useful function.

The race last year was flown over a 350 km. (217 miles) course at the Lido, near Venice, and was confined to Italy and Great Britain, America having found it impossible to prepare its machines in sufficient time for the race. An application for a postponement was made but the Committee decided against it.



The Schneider Trophy Course

The British entry, for the first time in the history of the race, was organised by the Air Ministry, for whom the machines were constructed. R.A.F. officers were detailed to form the British team, the actual personnel being Squadron Leader L. A. Slatter, Flight Lieuts. S. M. Kinkead, S. N. Webster and O. E. Worsley, and Flying Officers H. M. Schofield and T. H. Moon, the last-named being the technical officer. Of these, Kinkead, Webster and Worsley actually took part in the race, flying respectively the Gloster-Napier 4, a Supermarine S5 fitted with geared Napier engine, and a Supermarine S5 with a direct-drive Napier engine. Flying Officer Schofield was detailed to fly the Short-Bristol "*Crusader*" that also was sent to Venice, but unfortunately this machine crashed during a preliminary flight and became a total wreck. Schofield escaped with his life but had to be taken to hospital.

The race originally was scheduled to take place on 25th September, but unfavourable weather conditions compelled a postponement until the following day. By midday on the 26th conditions had improved sufficiently to enable a start to be made and at 2-30 in the afternoon, almost to the minute, the loud report of a gun signalised the Gloster-Napier's take-off. Five minutes later Col. the Marquis de Bernardi, Italy's principal hope,

took off on a Fiat-engined Italian Macchi machine, and at five-minute intervals following came successively Webster on his Supermarine-Napier, Guazzetti, Worsley and Ferrarin. Both Guazzetti and Ferrarin flew Macchi machines, painted a blood-red colour.

From the map of the course it will be seen that two of the turns were practically hairpin bends, and it was here that tactics told. The British machines took the turns gradually and, keeping low, made a pronounced bank at the last moment. The Italians preferred to bank violently until the machines were almost over the vertical, with the result that they shot high up into the air. When they flattened out it was clearly seen that the dive back to the earlier level was not compensating for the speed lost during the climb. The British machines gained heavily at every turn, and in this respect there was little to choose between any of the three British pilots.

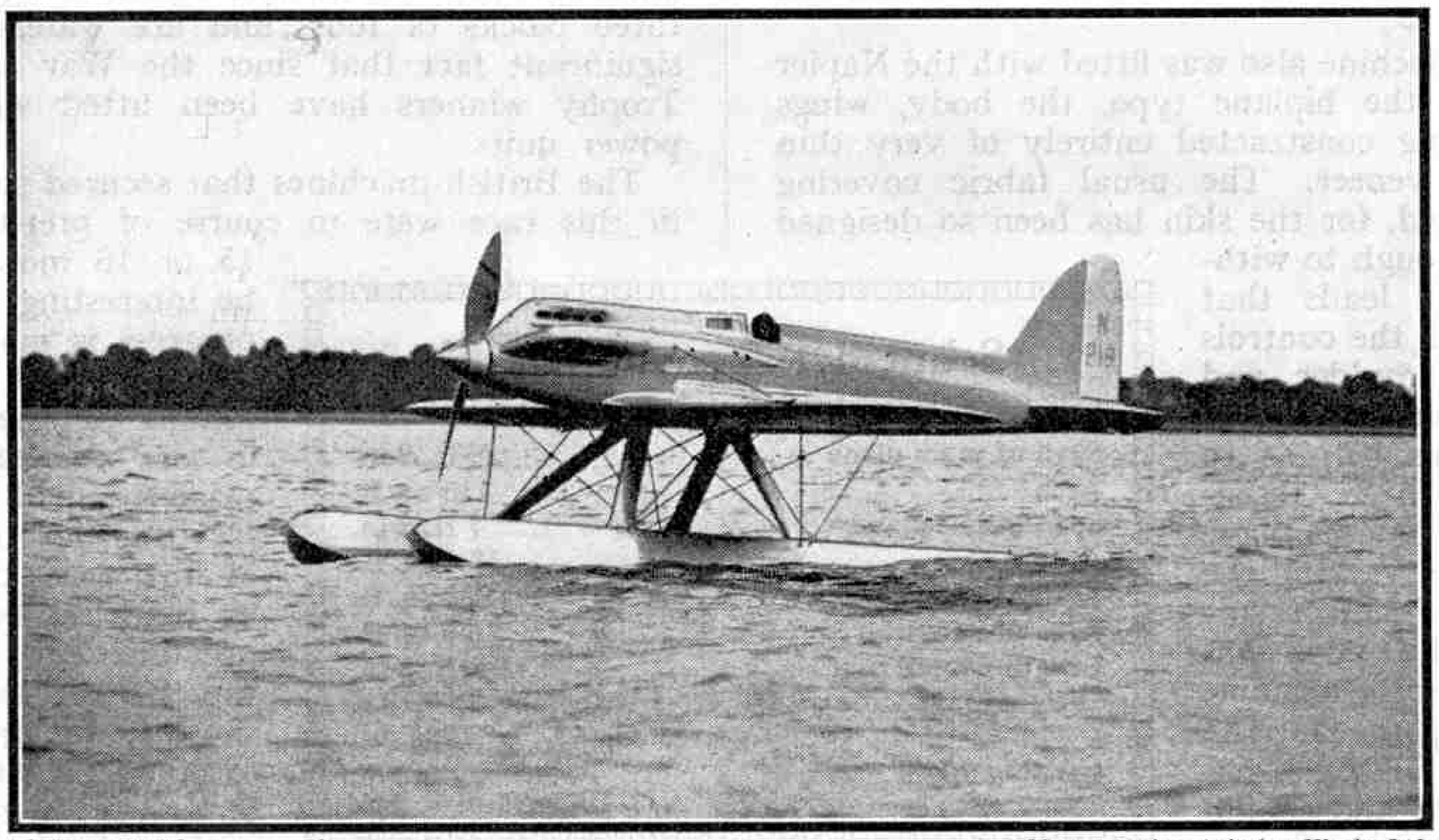


Photo courtesy] [*Supermarine Aviation Works Ltd.*

A Supermarine-Napier "S5" racing monoplane "taxi-ing" during tests

The early stages of the race gave every promise of a desperate fight. Kinkead's and Bernardi's first laps showed a gain of but one second for Britain, but then came the Italian disasters. First, Ferrarin was seen to be flying back to the starting point well off the course, obviously suffering from engine trouble. At the end of the second lap, Bernardi failed to appear; he also had encountered engine trouble. The British machines were still roaring on, with Kinkead improving his lap times with each lap. From the end of the third lap, however, the Gloster's speed fell back slightly, and in the sixth the collapse of its spinner forced Kinkead to retire.

There were now only three machines left in. Worsley seemed to be flying neck and neck with Guazzetti, while Webster was lapping very steadily at a speed approximately seven or eight m.p.h. faster than either his colleague or the Italian. With the sixth lap Italy's crowning disaster came. At the Lido turn the Macchi was seen to bank violently and shoot higher than usual. Worsley, keeping his machine well down, made the turn clearly ahead of Guazzetti and steadily increased his lead as the machines continued. It is stated that Guazzetti realised that his engine was almost at its last gasp and made the high climb deliberately to avoid any possibility of colliding with his opponent when he dived. This act of chivalry deserves to be placed on record. Before reaching the further end of the course the Macchi petered out and Italy was out of the race.

With only two machines remaining, and those both British, the concluding stage of the race was somewhat in the nature of an anti-climax. Neither Webster nor Worsley took chances but, without reducing their speeds, completed the course safely. To make assurance doubly sure Webster did an extra lap before flying off the course. Worsley followed soon after, a worthy second. Webster's speed for the complete course showed the remarkable average of 281.54 m.p.h.; Worsley's speed was 272.96 m.p.h.

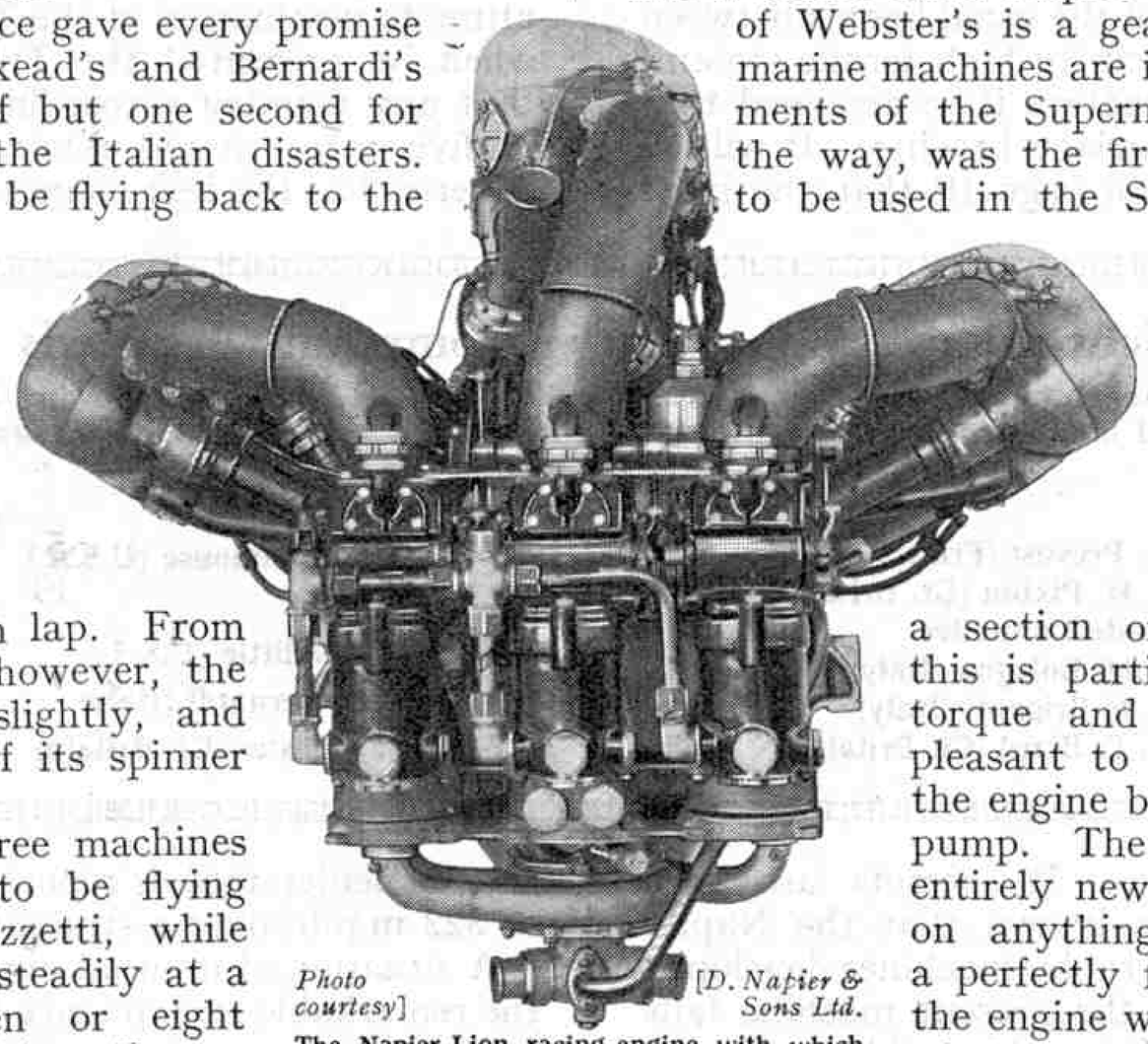


Photo courtesy] [*D. Napier & Sons Ltd.*

The Napier-Lion racing-engine with which each of the British machines was fitted. Its power is a closely-guarded secret but is believed to be approximately 1,000 h.p.!

With the exception that the machine flown by Worsley has a direct-drive Napier "Lion" engine, while that of Webster's is a geared engine, the two Supermarine machines are identical. Both are developments of the Supermarine-Napier S4 which, by the way, was the first monoplane float seaplane to be used in the Schneider Trophy Race, and which created a world's speed record for seaplanes in 1925.

Only a few of the S5's many novel features are available for publication. All the fuel is carried in the starboard float, the tank being constructed as a section of the float. The effect of this is partially to balance the engine torque and make the machine more pleasant to fly. The fuel is carried to the engine by means of an engine-driven pump. The wing surface radiators are entirely new and are a definite advance on anything previously used. Having a perfectly flat outer surface, they cool the engine without adding any resistance whatsoever to the machine. The fuselage is constructed entirely of metal, the skin taking practically all the stresses. The engine mounting consists of a cantilevered extension to the fuselage, and the skin of the mounting carries all the engine loads.

The floats are constructed of duralumin, specially treated to resist sea-water corrosion. The wing is built of

wood and is covered with special laminated wood underneath the radiators.

The fuselage is probably smaller in cross-sectional area than any previously designed and the pilots had to be specially fitted to the machines. Fresh air ducts are fitted to clear the cockpit of exhaust fumes and hot air during flight.

The Gloster 4 machine also was fitted with the Napier engine. It is of the biplane type, the body, wings and tail unit being constructed entirely of very thin skins of spruce veneer. The usual fabric covering has been eliminated, for the skin has been so designed as to be strong enough to withstand all the air loads that come upon it. All the controls for the ailerons, rudder and elevator are operated inside the structure, thus helping to keep down the head resistance. Patented devices have been employed for varying the movement of the control surfaces so that the pilot has greater control over the machine when flying at top speed. The floats are of the Gloster Company's own design and manufacture, and, like the Supermarine's, are constructed entirely of duralumin specially treated to withstand the effects of sea water. The part that the float design plays in the evolution of a successful racing machine cannot be too highly estimated. Not only must the floats be capable of allowing the machine to rise rapidly and easily from the water, but when the machine is in the air they must present a minimum of resistance. This has been achieved. Part of the success is due to the removal of the usual booms between the floats and their replacement by high tensile streamline wires; also the wing structure is so arranged that it forms part of the under-carriage bracing. It will be noted from the photograph on page 19 that the roots of the upper wing fair into the outer banks of cylinders of the Napier engine. The wing span, 22 ft. 6 in., is even smaller than that of the Supermarine.

Too much praise cannot be given to the Napier "Lion" engine for the success of the British entry. Its secrets are very closely guarded but, as it is known that the Napier engine in the 1925 Schneider Trophy machines developed 700 h.p., it is probable that the present machine falls very little below 1,000 h.p.! It is not possible to divulge the nature of all the alterations that have been made to the 1925 engine, but important among them is a substantial reduction in the frontal area. This makes the engine even more compact than the existing standard "Lion" engine.

Another considerable advance is the fitting of the engine with a special reduction gear, which enables a slower-running air-screw to be used while securing a higher degree of efficiency. The engine used in Webster's machine is the first high-powered geared racing engine that has been produced, and this alone marks a unique development in British aero-engine design. The engines each have 12 cylinders arranged fan-shape in three blocks of four, and are water-cooled. It is a significant fact that since the War all the Schneider Trophy winners have been fitted with water-cooled power units.

The British machines that secured so signal a success in this race were in course of preparation for some 15 or 16 months, and it will be interesting to observe what progress is made between now and the 1928 race. The conditions of the next race are in our favour. In the first place we shall be "at home"; for it is one of the conditions of the race that it is flown in the country that won the previous race. In addition, the British victory last year showed an increase in speed of 35 m.p.h. as compared with an average increase of 27 m.p.h. with each of the previous four races. Thus we have already a few miles in hand, although too much faith must not be placed in this apparent advantage. The successful Italian machine of 1926 actually produced an increase of 80 m.p.h. above that achieved by the Italians in 1925, and America did not disclose its hand last year.

The next three races, 1928, 1929 and 1930, will be of unusual interest, for on their results depends the ultimate destination of the Trophy itself. M. Schneider, when he presented the Trophy, made it a condition that any country succeeding in winning it three times in five races should retain the Trophy permanently. America has the best chance of doing this having only to win this year.

It was unfortunate that the U.S. entry was unable to be completed in time for the race, particularly in the light of subsequent events. Lieut. Williams of the U.S. Air Services, flying the machine he was to have piloted in the Schneider race, is reported to have attained a speed of 322 m.p.h. over a straight course!

A situation of unusual piquancy arose last year out of the remarkable resemblance between the Macchi and the Supermarine machines. One Italian journal, in fact, openly suggested that the Supermarine was a flagrant copy of the Macchi machine that gained the trophy in 1926! This statement is far from being correct; the true position is that the designers of the S5 *and of the 1926 Macchi* both took the 1925 Supermarine S4 as the base for their new designs and, following a common line of reasoning, achieved similar results.

Schneider Trophy Race

Dimensions of the S5 machine

Span of main plane	26 ft. 9 in.
Area „ „	115 sq. ft.
Span of tail plane	7 ft. 8 in.
Area „ „	13.4 sq. ft.
Area of elevator	6.3 sq. ft.
Area of rudder	6.6 sq. ft.
Length overall	24. ft. 2 in.
Weight of machine with direct-drive engine	3,032 lbs.
„ „ „ geared engine	3,200 lbs.
Landing Speed	90 m.p.h.

Schneider Trophy Race—Comparative Speeds

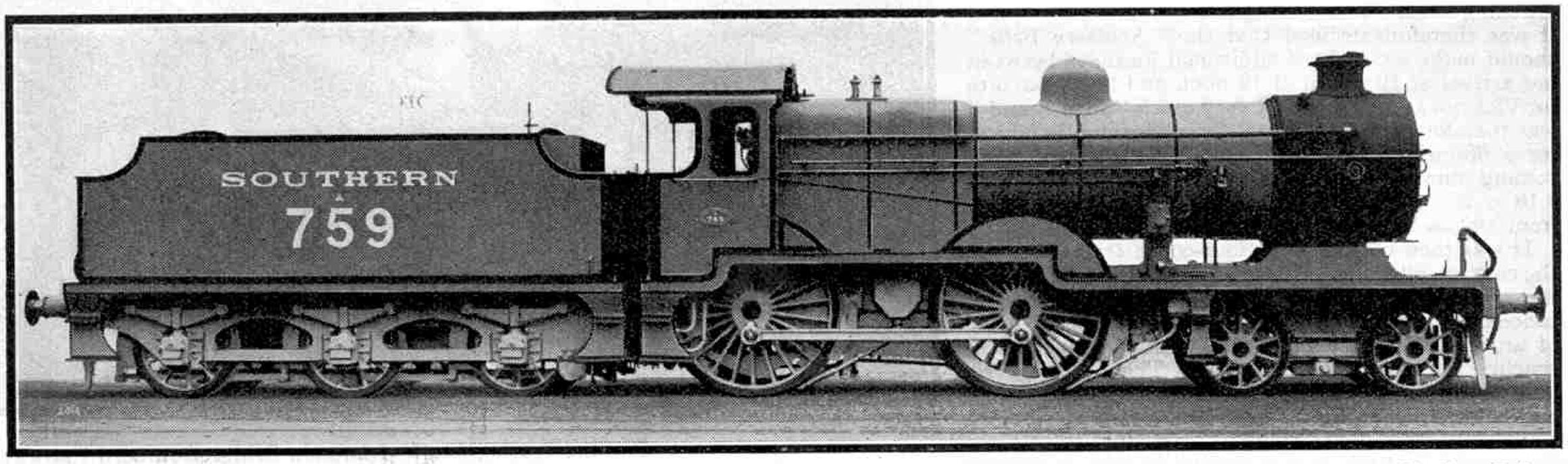
The reference to the speeds achieved at previous contests make the following figures of special interest. They show the actual winners and speeds since the inauguration of the race

	M.P.H.		M.P.H.
1913—M. Prevost (France) ...	45.75	1923—Lt. D. Rittenhouse (U.S.A.)	177.38
1914—C. H. Pixton (Gt. Britain)	86.8	1924—No contest	
1919—Contest annulled		1925—Lt. J. Doolittle (U.S.A.)	232.57
1920—Luigi Bologna (Italy) ...	107	1926—Maj. de Bernardi (Italy)	246.49
1921—G. le Briganti (Italy) ...	111	1927—S. N. Webster (Gt. Britain)	281.54
1922—H. C. Biard (Gt. Britain)	145.7		

FAMOUS TRAINS: XIII.

The "*Southern Belle*" and the "*Folkestone Flyer*," Southern Railway

By Cecil J. Allen, M.Inst. T., etc.



Courtesy] [*Southern Railway*

Latest Type "L" class 4-4-0 Express Engine, Southern Railway

SIXTY years ago, a Chicago resident named George Pullman conceived the idea that travel in the United States of America might be made much more comfortable if some private individual with sufficient enterprise were to build a more luxurious type of car than ever previously employed, and then either lease the cars to the railways, or pay a rental to the railways for running them and recoup himself by the amounts paid by the passengers in supplementary fares. The idea caught on. Pullman sleeping cars and Pullman drawing-room cars rapidly came into use all over the United States and to-day no express train there or in Canada runs without this type of equipment.

The progress of the Pullman in Europe has been less rapid. It was in 1875 that the first Pullman car came to England. The Midland Railway, having seven years previously extended its tentacles southward into its London terminus at St. Pancras, and being anxious to wrest passenger traffic from its old-established rivals on both sides, introduced Pullman sleeping cars as a special form of luxury equipment between London and Glasgow, and also Pullman drawing-room cars between St. Pancras and Manchester. But on the Midland the Pullman idea did not find much favour, for some reason or other, and to-day—there is almost tragedy in the comparison—the bodies of the old cars may be discovered doing the duty of lineside shelters for shunters and others near the Central Station at Manchester, outside Nottingham, and elsewhere!

Leading Dimensions of Southern Railway Locomotive Types mentioned in this Article

Type	4–6–4 Express	4–4–2 Express	4–4–0 Express
Tender or Tank	Tank	Tender	Tender
Class	"Stephenson"	Superheated	Latest "L"
Cylinders, diameter	22 in.	21 in.	19½ in.
,, stroke	28 in.	26 in.	26 in.
Driving Wheels, diameter ...	6 ft. 9 in.	6 ft. 7½ in.	6 ft. 8 in.
Heating Surface, tubes ...	1,535 sq. ft.	1,913 sq. ft.	1,252 sq. ft.
,, ,, firebox ...	152 ,,	137 ,,	155 ,,
,, ,, superheater	383 ,,	461 ,,	235 ,,
,, ,, total ...	2,070 ,,	2,561 ,,	1,642 ,,
Firegrate Area	26.7 ,,	31.0 ,,	22.5 ,,
Working Pressure, per sq. in.	170 lb.	170 lb.	180 lb.
Tractive Effort, at 85 per cent.	24,175 lb.	20,840 lb.	18,885 lb.
Adhesion Weight	56½ tons	37½ tons	38 tons
Weight of Engine	98 ,,	68½ ,,	58½ ,,
Water Capacity	2,700 gals.	3,500 gals.	3,500 gals.
Coal ,, ...	3½ tons	4 tons	5 tons
Weight of Engine and Tender (in working order)	——	109 tons	99 tons
Length of Engine and Tender, overall	50 ft. 5 in.	57 ft. 10 in.	56 ft. 8 in.

The next introduction of Pullman cars was in 1879 on the old London, Brighton and South Coast Railway, where, on the short journeys between London and the South Coast resorts, the open type of drawing-room car immediately found favour. All three sections of the present Southern Railway—the South Eastern and Chatham, the Brighton and the London and South Western—experimented with Pullmans, but whereas the South Western, which worked them for some years between Waterloo and Bournemouth, abandoned them eventually in favour of restaurant cars, on the other two sections the Pullman business has gone up by leaps and bounds. Suffice it to say that in the summer of 1927 no less than 114 trains were running daily on the Brighton and South Eastern sections of the Southern with Pullman cars attached—first-class only in the latter case, but first and third-class on 44 of the Brighton trains and third-class only on six more.

It was in the year 1908 that the first daily all-Pullman express appeared in the British Isles, and to the London, Brighton and South Coast Company belongs the honour of its introduction. For ten years previously a first-class "Pullman Limited" express had been running from Victoria to Brighton and back on Sundays, covering the 51 miles in the even hour, but there had been no such time operating on weekdays. The new train was therefore arranged to leave Victoria at 11 a.m. daily and to reach Brighton at 12 noon. To mark the occasion suitably, a distinctive name was chosen—that of "*Southern Belle*"—for

the new service, and in view of the adoption 15 years later, of the title "Southern Railway" by this group of lines, the name could scarcely have been improved on.

An entirely new set of twelve-wheeled Pullman cars, seven in number, was built to make up the "*Southern Belle*," and the boast on their introduction that this was the most luxurious train in the world was at that time very likely not without foundation. The whole set of seven cars was required for Sunday use, but on weekdays this formation was generally cut down to four, as for some years first-class passengers only were carried and four coaches provided sufficient accommodation. It was next thought that this magnificent coaching stock was not being put to sufficient use, and it was therefore decided that the "*Southern Belle*" should make a couple of additional journeys between her arrival at Brighton at 12 noon and her departure for Victoria at 5.45 p.m. A very quick "turn-round" was therefore arranged, the "*Belle*" leaving Brighton for a 60-minute run to London at 12.20 p.m., and coming down again from Victoria to Brighton at 3.10 p.m. This increased the mileage of the stock from 102 to 204 miles daily.

It was then realised that four-coach trains, even if the cars are all Pullmans, are a wasteful proposition in these days of powerful modern locomotives, and a concession to democracy was decided upon in the form of an addition on weekdays of ordinary third-class coaches to the train formation. These proved so immensely popular that, after the Brighton Company had set up an entirely new standard in third-class travel by providing Pullman cars for third-class passengers, in 1915, it was finally decided to substitute third-class Pullman cars for the ordinary third-class coaches. This last substitution has taken place since the war, and once again, therefore, the "*Southern Belle*" is an all-Pullman express. Only in the summer is an additional brake-van attached for the conveyance of luggage; at other times Pullman cars alone are included in the formation.

During the height of the summer the "*Southern Belle*" shares with the 10.45 a.m. Pullman boat express to Dover the distinction of being the heaviest Pullman train in the country, and the task before the locomotives of completing the 51 miles between Victoria and Brighton in the hour is by no means an easy one.

In the earlier days of the "*Belle*" a variety of locomotives undertook its working. Often the four-coach train, and at times the seven-coach Sunday express, was entrusted to one of the fine Earle Marsh superheated 4–4–2 tanks of Class "I.3," which kept time without difficulty. On other occasions these would be supplanted by the large "Atlantics"—either the non-superheated engines of the 37–41 series, or the later superheated developments, Nos. 421–426. Then came the turn of the 4–6–2 tanks "*Abergavenny*" and "*Bessborough*," and, later still, of the magnificent Billinton 4–6–4 express tanks of the "Charles C. Macrae" series, the last-named being powerful express engines in every respect other than that of carrying a separate tender for fuel and water supply. They were provided, indeed, with the largest cylinders ever fitted to a British two-cylinder single locomotive (other than the similarly-dimensioned Urie 4–6–0 engines of the London and South Western), 22 in. in diameter by 28 in. stroke, with the result that their tractive effort reached the high figure of 24,175 lb.

Now, however, in the march of progress, the ubiquitous 4–6–0 "King Arthur" tender engines are chiefly concerned in the working of the "*Southern Belle*" and the other Brighton 60-minute expresses. A special series of these engines has been built, provided with six-wheeled tenders instead of the eight-wheeled tenders in use on other sections of the Southern line, as being more suited in coal and water capacity to the short runs of the Brighton section. The 4–6–4 tanks still take a hand in running the "*Belle*" at times, and sometimes also the 2–6–4 Maunsell tanks of the "River" class; but in general it is a "King Arthur" that will be found at the head of the train. The times of the service have been altered, by the way, since "systematic" departure times were adopted on the Central Division, in common with the other divisions of the Southern Railway.

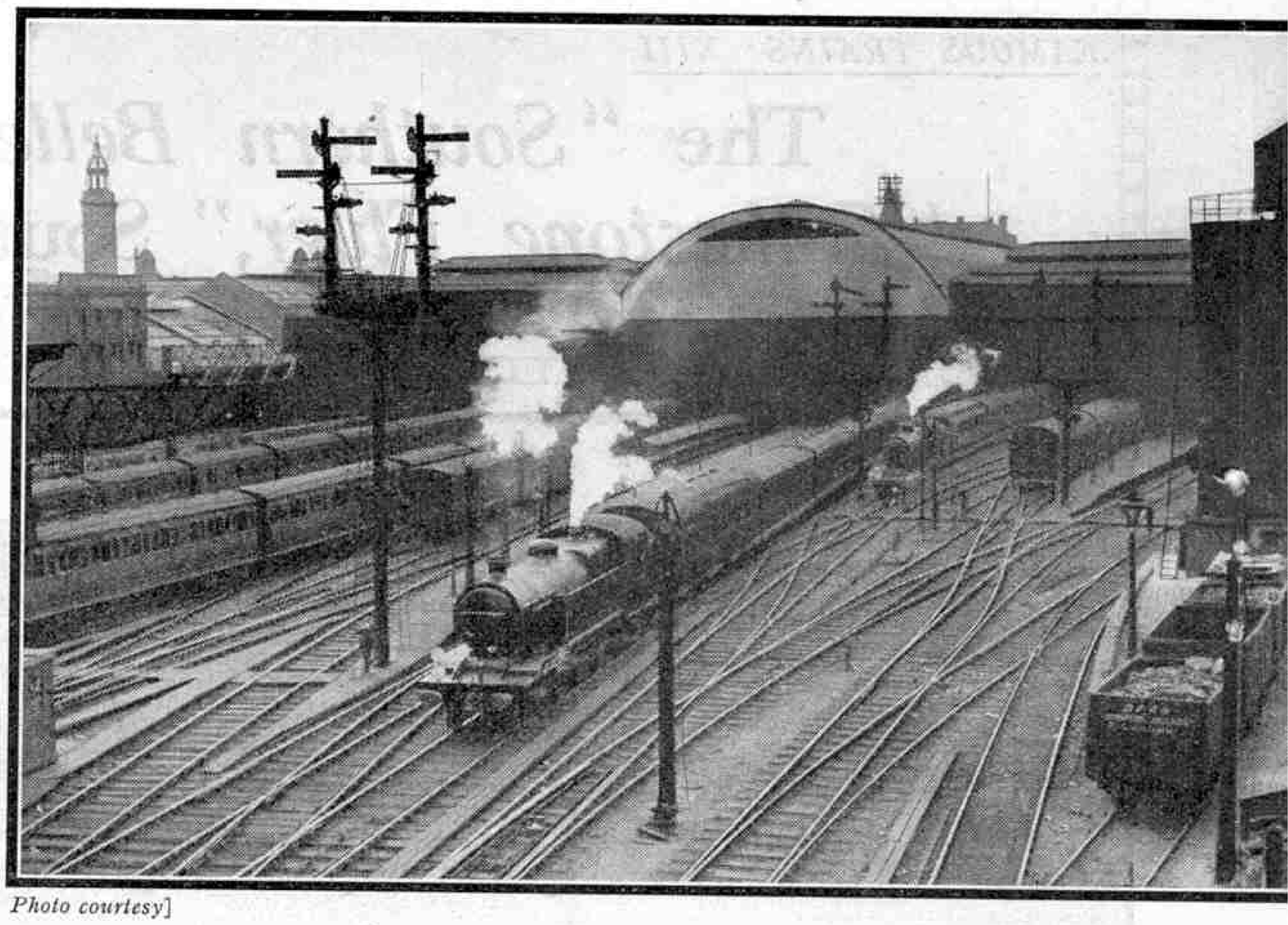


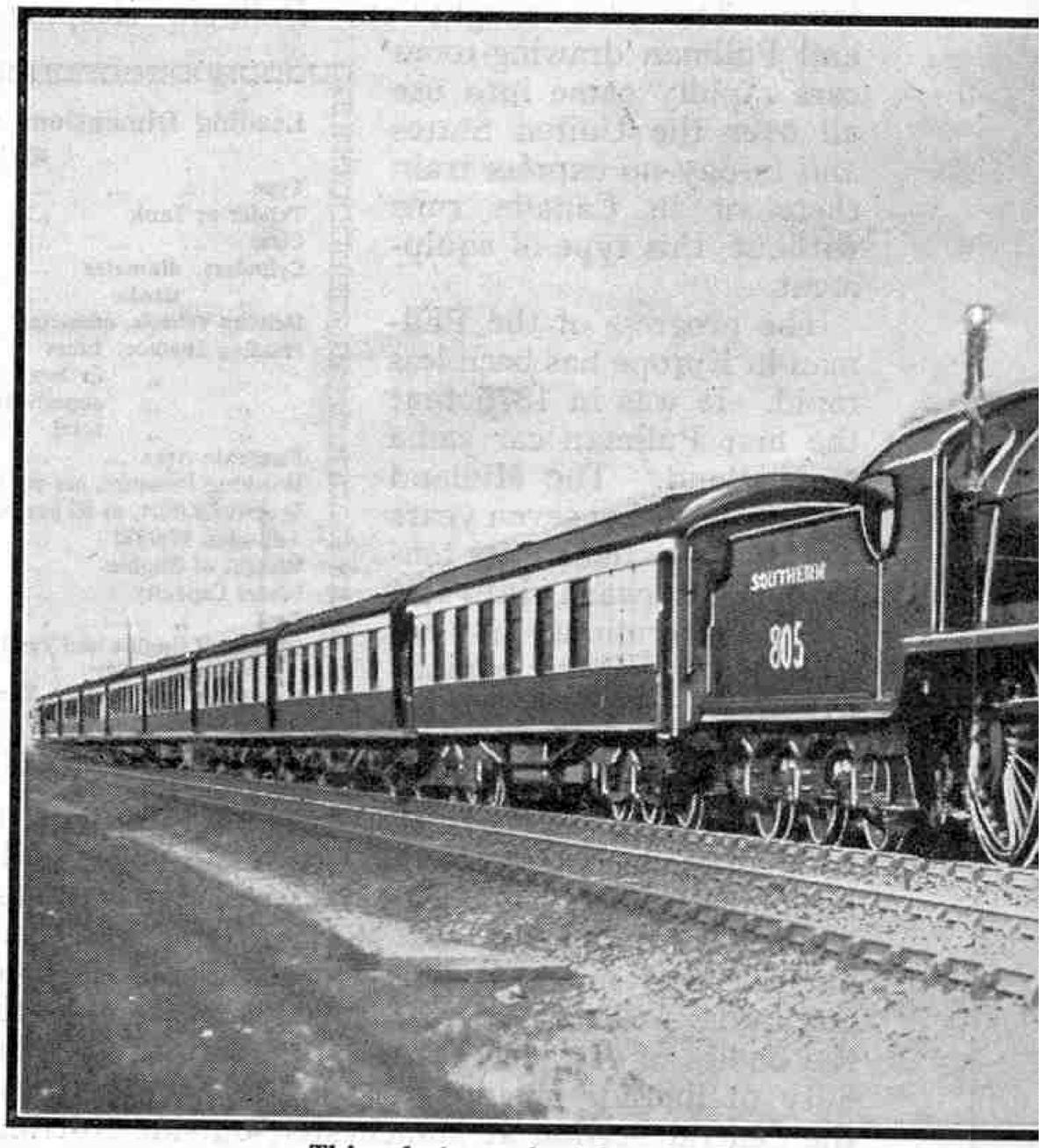
Photo courtesy]

Parallel Tracks, South of London Bridge, Southern Railway. The Foll

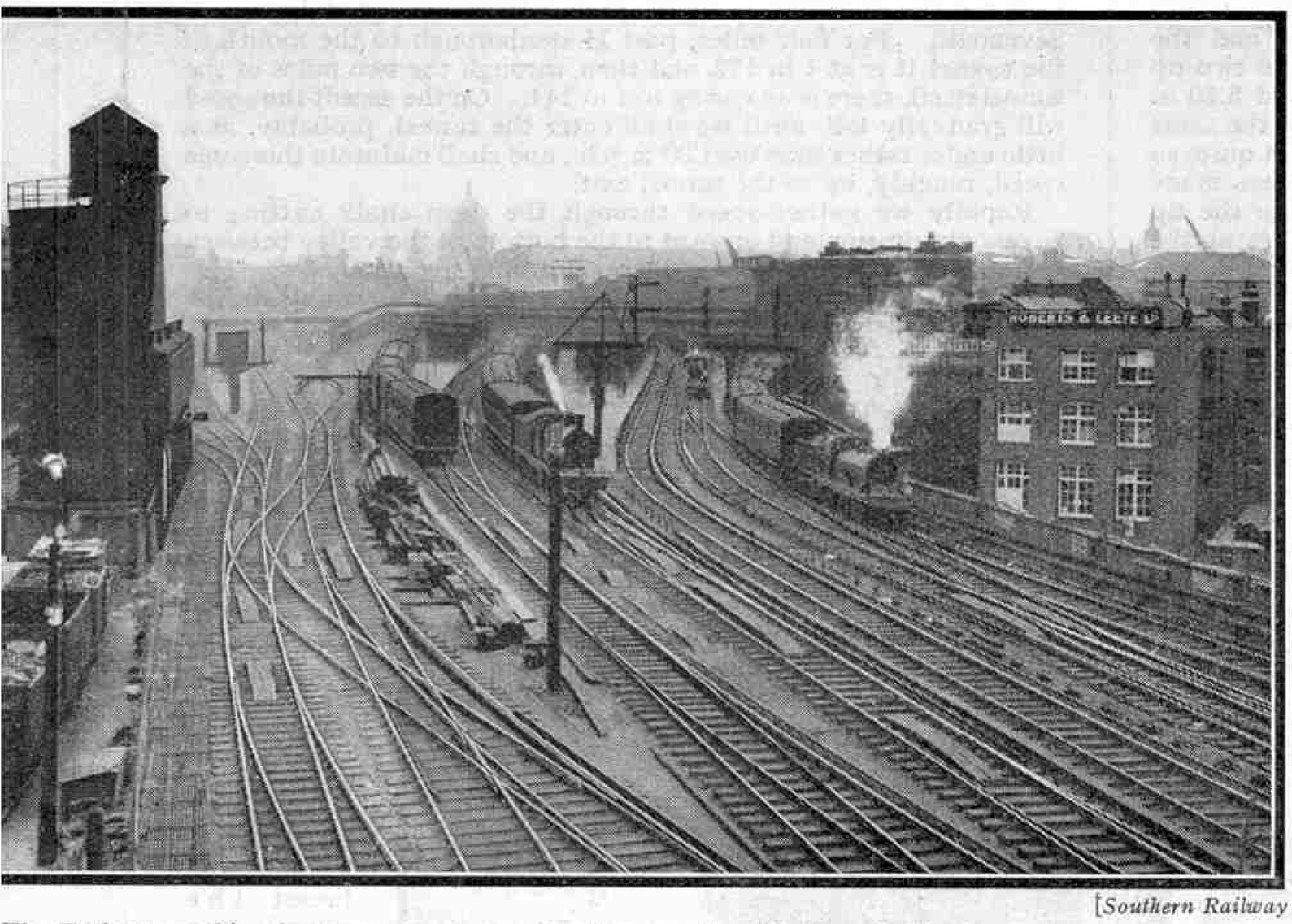
So the down "*Southern Belle*" leaves Victoria at 11.5 a.m. and 3.5 p.m., and the return times are 1.35 p.m. and 5.35 p.m. from Brighton to Victoria.

We shall find the train, probably, in the last platform but one at the extreme right-hand side of Victoria station, with the third-class Pullmans in front and the first-class behind, to a total on weekdays, of eight or nine cars in the winter and probably ten in the summer. The hardest effort required of the engine, going south, is the rise out of Victoria to the Grosvenor Bridge over the Thames. This is slightly easier in grading than from the South Eastern side of the terminus, being 1 in 64 as against 1 in 61; but even so the half-mile of climbing, starting right off the platform end, is a tough proposition, more especially as rear-end assistance is seldom employed.

Once across the river we accelerate rapidly, swinging over the South Western main line to run parallel with it as far as Clapham Junction, which we pass at about 45 miles an hour, some six minutes after starting. Between here and Brighton the main line has three well-defined summits, each crowned with a tunnel; these are near Merstham, some 18 miles after starting, Balcombe, 32½ miles, and Clayton, 46¼ miles, the line dropping between each two summits to its lowest points at Horley, 26 miles out, and Wivelsfield, just beyond Haywards Heath and 40½ miles from the start. Between Croydon and Brighton the gradients are mostly in long even stretches at



This photograph, taken by F. E. Mackay, shows



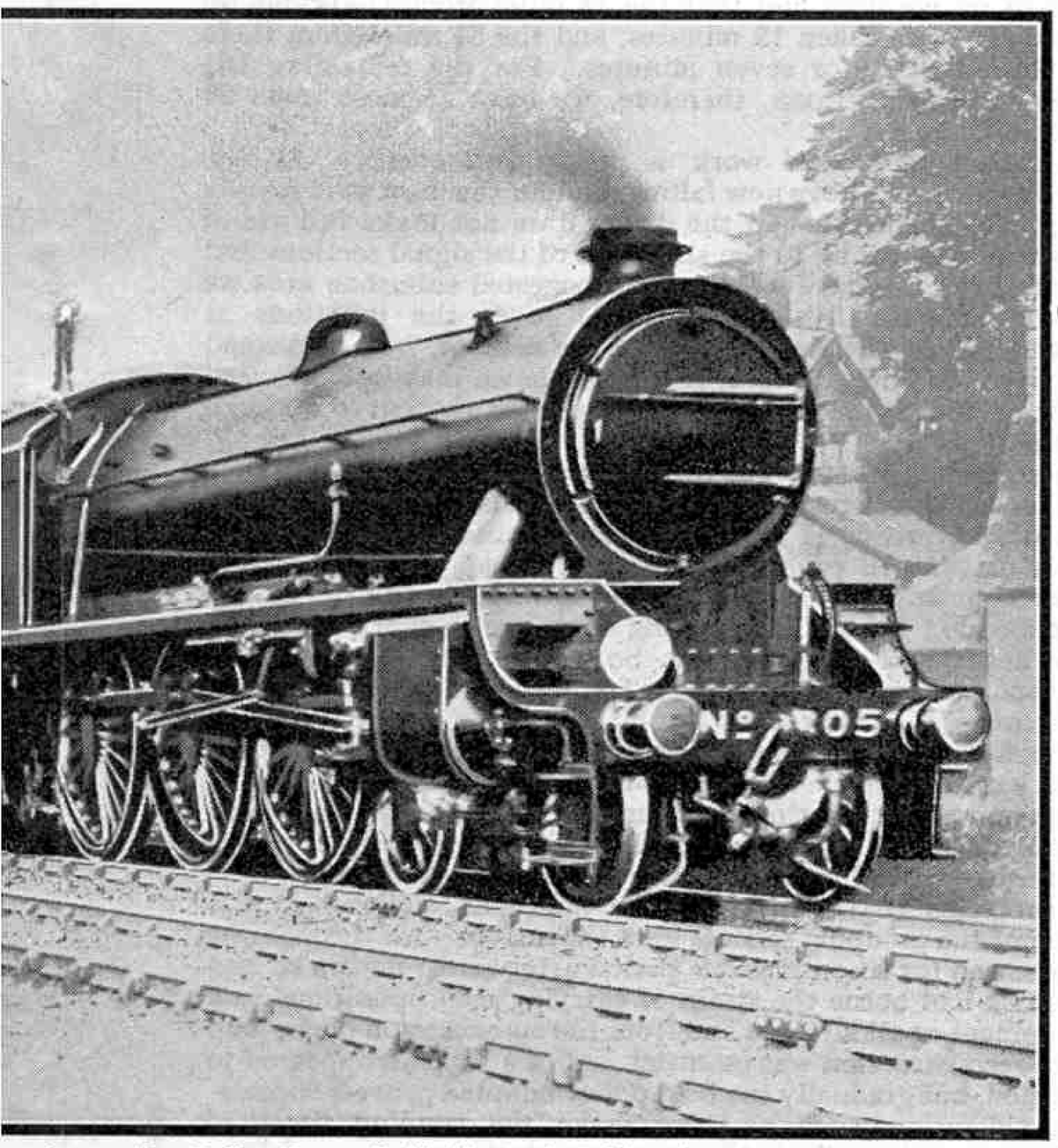
[*Southern Railway*

The Folkestone 80-minute expresses use the lines on the right-hand side

1 in 264, up to the tunnels and down to the hollows, the only steeper lengths being 2¾ miles at 1 in 165 from Coulsdon up to Quarry Tunnel, and four miles mostly at 1 in 200 through the tunnel and down to Earlswood.

On the rising gradients from Clapham to Balham at 1 in 166 and 94, we fall to about 40 m.p.h. or a shade under, but then probably work up to 55 m.p.h. or thereabouts through Streatham Common. On the further rise, to Selhurst, speed falls again somewhat and is then moderated through the maze of junctions that brings us on to the original London and Brighton main line at Windmill Bridge, just south of Croydon. East Croydon, 10½ miles from the start, is passed in about 16 min., leaving 44 min. only for the remaining 40½ miles to Brighton.

It is a long stretch "against the collar" from Croydon up past Purley and Coulsdon to "Quarry" summit. At Coulsdon we leave behind us the electrified lines and cross over the old joint Brighton and South Eastern tracks to the right of them, on to the avoiding line that the Brighton Company opened in 1900 to give them an independent route from here to Earlswood, on the other side of Redhill, where the original main line is rejoined. Up the 1 in 264 to Coulsdon we maintain 50 an hour, or slightly under, falling to 45 or less on the 1 in 165 ere we enter Quarry Tunnel, which is just over a mile in length.



, shows the "*Southern Belle*" passing Star Lane

Then follows a swift dash down past Earlswood to Horley, where we may touch anything from 65 up to 75 m.p.h., according to driver and engine. The impetus of this probably will carry us up the 1 in 264 past Three Bridges to Balcombe Summit, which is just before the entry to Balcombe Tunnel, at between 50 and 55 m.p.h. Then another downward dash past Haywards Heath and Wivelsfield to Keymer Junction, where the Eastbourne line diverges on the left, will produce a second maximum, probably over 70 m.p.h. Rising to and through Clayton Tunnel, which also exceeds a mile in length, we probably drop slightly below 50 m.p.h., and then, with very gentle running down the final incline to Preston Park, we draw slowly round the sharp curves and up the long platform at Brighton Central, to a dead stand probably just on the stroke of 12.5 noon. Timekeeping is none too easy with all the congestion of this busy route, but it is seldom that the "*Belle*" is more than a minute or two out at either end of her journey.

It is of interest to note, by the way, that the fastest time ever achieved between London and Brighton was made by the 4–4–0 engine "*Holyrood*," with the down Sunday "Pullman Limited" on 26th July, 1903, when the journey of 50.9 miles was completed in the remarkable time of 48 minutes, 41 seconds. It is claimed that on that occasion a maximum speed of 90 miles an hour was attained at Haywards Heath.

* * * *

What an extraordinary revolution has taken place in railway travel in the south-east of England in the last twenty years! At the beginning of the present century the South Eastern and London, Chatham and Dover lines were the butt of every humorist who wanted to make capital out of our railways. For slow, late and uncomfortable running the South Eastern was held on all hands to have few rivals, and not, it must be admitted, without some reason; but to-day all that is totally changed. On such trains as the 80-minute Folkestone expresses, which form the subject of our study this month, you may witness some of the fastest railway travel in England. Up-to-date Pullman cars and comfortable corridor coaches make up the trains and you can have meals and light refreshments brought to you wherever you sit.

Since the war, while the great trunk lines to the North of England have been content, in the main, gradually to restore their pre-war speeds, the Southern has established, especially in its Eastern territory, scheduled train-speeds considerably faster than any previously attempted. So the time between London and Folkestone has been brought down successively to 90, to 85 and now to 80 minutes by the best expresses.

The distance from Charing Cross to Folkestone Central is almost exactly 70 miles, giving an average booked speed of 52½ m.p.h. from start to stop. But when allowance is made for the slow exit round all the sharp curves from Charing Cross to London Bridge, for the congestion of the suburban area, for the tremendous climb from New Cross to Knockholt and, last of all, for the severe slack round the curve through Tonbridge Junction just when the speed is ruling high, it will be seen that there is no time to spare. In fact the average rate over the dead straight and well-graded 40½ miles between Tonbridge and Folkestone must be round about a mile-a-minute throughout, if time is to be kept, and the maximum speeds must be considerably higher than this.

While the speed of these trains has been going up, so the weight of them has been constantly on the increase also. The latest 32-ton corridor coaches have now been introduced, seven of which, in addition to the Pullman car, of between 33 and 40 tons, make up at least 255 tons, and with passengers and luggage some 270 or 275 tons behind the tender. If an additional coach be added, the total is over 300 tons. This is a truly formidable task of haulage for the 4–4–0 locomotives invariably employed. Until 1927 these were generally of the large-boilered "L" class, introduced just before the war and numbered between 760 and 781; they were of special note in that 10 of them were built by the German firm of Borsig, at their Tegel works at Berlin. But last summer saw the advent of the new and more powerful superheated "L" locomotives, of Mr. Maunsell's design, which are now doing first-class work on these trains.

There are actually four trains timed to make the 80-minute run between Charing Cross and Folkestone. The 4.15 p.m. and the 7.15 p.m. are the two down expresses so booked, and the two up trains leave Folkestone Central at 11 in the morning and 5.10 in the evening. The 9 o'clock up makes London Bridge in the same time, but in this case, of course, the distance covered is not quite so great. As most of our journeys in these articles have been made from London, it will be somewhat of a novelty to take the up journey for once, and we will therefore imagine ourselves at the Central Station at Folkestone somewhere about 5 o'clock in the evening, ready to make the dash for town at 5.10 p.m.

Part of the train we shall find already waiting in the up bay platform, consisting probably of two corridor third - class brake coaches and a first and third corridor "composite." Immediately afterwards, at 5.2 p.m., the Deal and Dover portion arrrives. It has actually started its journey at Ramsgate at 3.38 p.m., and has come slowly round the coast over a curved and steep section of line with many stops, through Sandwich, Deal and Walmer to Dover, and thence right alongside the sea, threading a number of long tunnels and up through the Warren to Folkestone. The Pullman car is next the engine, with four corridor coaches behind it; but after the engine has been into the bay to fetch the Folkestone portion, the car is in the centre, with the coaches on either side vestibuled to it. Prompt to time at 5.10 p.m. we are away.

Photo] [*F. E. Mackay*

"*Kent Coast Express*," Eastern Division Southern Railway. The engine seen is similar in type, but rather smaller than the latest superheated "L" class locomotives

Some tremendously fast running lies immediately ahead of us. From Folkestone to Tonbridge the distance is 40½ miles, but according to the timetable we must pass Tonbridge Junction at 5.51 p.m.—that is, 40½ miles in 41 minutes from the start. To make matters more difficult, we have ahead of us, for five miles out of Folkestone to just beyond Sandling Junction, a continuous rise at 1 in 264. But all the way up this we shall find our engine steadily accelerating, and we shall probably get through Sandling, 4½ miles, at a speed of between 40 and 45 miles an hour, in some eight minutes from the start.

Now the galloping begins. There is a gentle down gradient from Westenhanger to Ashford, not steeper than 1 in 266 at any point, but the speed will rise until, probably, we are well above the "70" line, and our headlong dash past the locomotive works and through Ashford Junction will be thrilling indeed. Then follows a faint rise to a siding called Chart, after which are further faintly falling grades to Pluckley, and gentle ups-and-downs over the perfectly straight course onwards to Paddock Wood. Along here we shall reel off mile after mile at round about 70 miles an hour. On one fairly recent occasion, in fact, I timed one of the new "L" class engines, with a 340-ton train, to cover the 29.3 miles from Westenhanger to Paddock Wood in 24 min. 55 sec., which represents an average rate of 70.6 m.p.h. over the whole of this distance. On the run in question our speed rose twice to 76½ m.p.h., and we actually passed Tonbridge, 40½ miles in 39 min. 40 secs., from the start.

From Paddock Wood there is a rise towards Tonbridge, and immediately we have breasted it there comes the shutting off steam and the slowing for Tonbridge Junction, to 35 m.p.h. It could not come at a worse place, as we want all the impetus we can get here for the tremendous climb that follows immediately, up to Sevenoaks. For four miles, past Hildenborough to the mouth of the tunnel, it is at 1 in 122, and then, through the two miles of the tunnel itself, there is an easing to 1 in 144. On the ascent the speed will gradually fall, until we shall enter the tunnel, probably, at a little under rather than over 30 m.p.h., and shall maintain this same speed, roughly, up to the tunnel exit.

Rapidly we gather speed through the deep chalk cutting to Sevenoaks Station and onward to the bottom of the valley between there and Dunton Green, where climbing recommences. This final stretch of the ascent to Knockholt (two miles at 1 in 143), is not quite so steep as that from Tonbridge. After having touched about a mile-a-minute between Sevenoaks and Dunton Green, we shall clear the 1½ miles of Polhill Tunnel and breast the summit, in the chalk cutting just before Knockholt Station, at about 40 m.p.h. or slightly over. Although we have covered the 36 miles from Sandling to Tonbridge in 33 minutes or so, we shall find that the 7½ miles from Tonbridge up to Sevenoaks have taken 12 minutes, and the 5½ miles from there on to Knockholt 6½ or seven minutes. For the remaining 16½ miles on to Charing Cross, therefore, we have at most some 20 minutes left.

But the engine's hard work is pretty well over. All the way to New Cross we have now falling, and for the most part steeply falling grades ahead, though the driver dare not make full use of his opportunities, owing to the shortness of the signal sections and the possibility of signal checks in the congested suburban area we have now entered. We shall "ease" over the junctions at Orpington, but on the steepest part of the descent, from Elmstead Tunnel down to Hither Green, it is possible we may again exceed 70 an hour before the enforced slowing over the curve through St. John's.

If we are lucky, we may get through to Charing Cross without a signal check, but so crowded with trains is this maze of lines that it is hardly surprising if we fail to get an absolutely clear road. Still, our driver will probably contrive to keep his train on the move, without any stop or very severe slowing, though the curves between London Bridge and Charing Cross are so sharp that they must be negotiated with caution. So we roll over Charing Cross Bridge, and we may expect duly to come to rest at our platform at 6.30 p.m.

Although we have probably done enough travelling for the day, our train has not, and three-quarters-of-an-hour later another "L" class engine will be starting the same set of coaches on a return 80-minute dash to Folkestone. All credit to the Southern for such enterprising timings in difficult running conditions.

The problems that confronted the Southern Railway at the inception of the grouping scheme were enormous. All through the war years, and for a considerable period afterwards, its tracks and rolling stock had borne the strain of carrying men, munitions and war equipment of all kinds to and from the embarkation ports, and complete reconstruction was essential. For a time all appeared to be confusion, but gradually the bold policy adopted proved successful. Considerations such as these make the running times of the "*Folkestone Flyer*" all the more meritorious.

The New Meccano Motor Chassis

An Example of the Latest Meccano Construction

THE Meccano Motor Chassis forms not only an excellent example of the adaptability of the Meccano parts but also a striking illustration of the educational value of the Meccano system. It shows how, with the aid of a number of ordinary Meccano parts, any intelligent boy may build a complete working model that demonstrates the principles of modern motor engineering so well that replicas of it have been used to instruct pupils in numerous technical schools.

The motor chassis about to be described embodies numerous improvements upon models of a similar type that have been published previously, and it may be regarded as representing the latest Meccano practice. Amongst the improvements may be mentioned the unit principle of construction that has been adopted. The motor, clutch and gearbox are all mounted on a rigid frame, which may be detached from the chassis merely by loosening two or three screws. The differential and rear axle casing, with torque rods, etc., also form a complete unit, the removal of which is the work of a few seconds only.

The gearbox provides three speeds forward and reverse gear, and is controlled by a central gear-change lever sliding in a quadrant that retains it in position after each change is effected. The clutch is controlled by a foot pedal and providing that a small rubber ring is used in the manner to be described later, the drive from the motor may be taken up very smoothly and gradually and transmitted to the road wheels. The differential gear has been improved and made more compact. The back axle unit is mounted on cantilever springs and any twisting tendency set up by the thrust of the propeller shaft is counteracted by torque rods attached to the main frame by a spring connection.

The steering gear is designed according to the Ackermann principle, which provides for a different angle of turning movement in each front road wheel. Internal expanding brakes are attached to the rear wheels and a pedal-operated brake is fitted to the cardan shaft immediately in front of the universal joint. Other refinements of the model include a radiator cooling fan and a motor starting switch mounted on the dashboard.

The chassis will carry easily the weight of the Meccano 8 ampere-hour Accumulator, even on top gear. The Accumulator should be placed on the luggage carrier at the rear of the model, thus converting the chassis into a self-contained power unit. A complete list of parts required to build the model will be found at the end of this article.

The Frame and Springs

The construction of the model should be commenced by building the main frame, which is shown more clearly in Fig. 2. Each side consists of two 12½" Angle Girders 1 bolted together in the form of a channel section to give maximum rigidity. The side girders are held together by a cross member 2 composed of a 5½" Angle Girder and their front ends are extended by 5½" Curved Strips to carry the ends of the front semi-elliptic springs. Each inner 5½" Curved Strip is secured to the upper Girder of its respective side member by means of two Angle Brackets. Two of the bolts that serve to secure the Curved Strips also serve as pivots for the shackles (Flat Brackets 3) supporting the rear ends of the front springs (see also Figs. 4 and 6). The bolts should be secured to the side members by two locked nuts (see Meccano Standard Mechanism No. 262) so that the Flat Brackets are quite free to turn on their shanks.

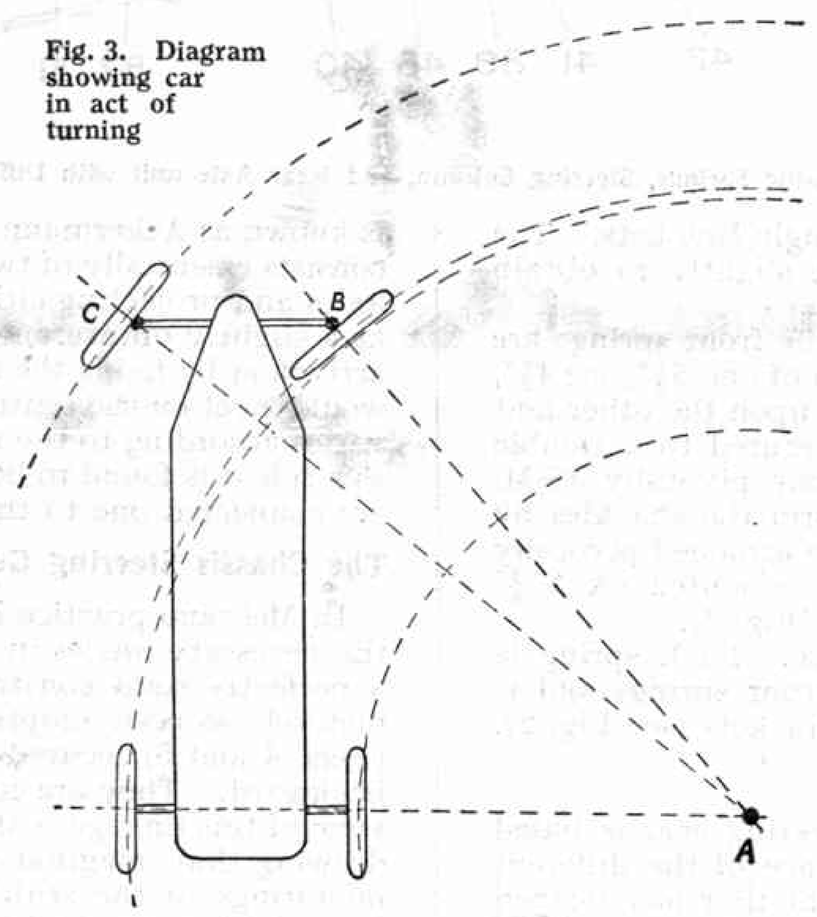


Fig. 3. Diagram showing car in act of turning

The main frame is extended and carried over the back axle by means of a series of 2½" large radius Curved Strips 4 bolted together in the manner shown. The luggage carrier 5 is composed of two 3" Strips connected by four 4½" × ½" Double Angle Strips. The carrier is bolted to the end holes in the main frame, and nuts on bolts 6 inserted in the end holes of the 3" Strips strike against the Curved Strips 4 and thereby maintain the carrier in a horizontal position. The carrier is designed to hold the Meccano 8 amp. Accumulator, and when not in use it may be folded back.

The radiator is represented by a 3½" × 2½" Flanged Plate 7 with two 3½" × ½" Double Angle Strips bolted at the sides. It is secured to a 4½" Strip 7a secured between the front 5½" Curved Strips of the frame. The 5½" × 2½" Flat Plate 8 is secured to a 5½" Angle Girder bolted to the main side Girders 1 and is extended at the top by a 5½" Strip 9 secured at each end by Flat Brackets. The dashboard 10 consists of a 5½" Strip and a 5½" Curved Strip attached

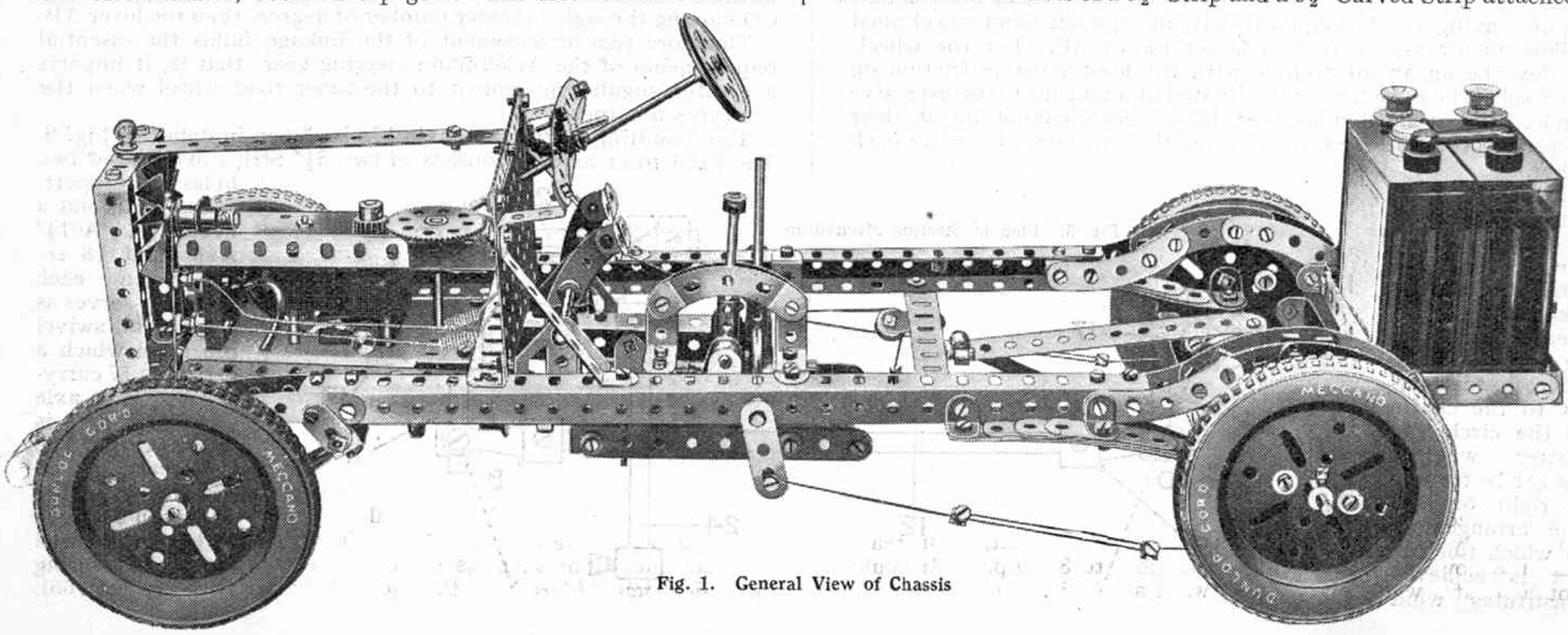


Fig. 1. General View of Chassis

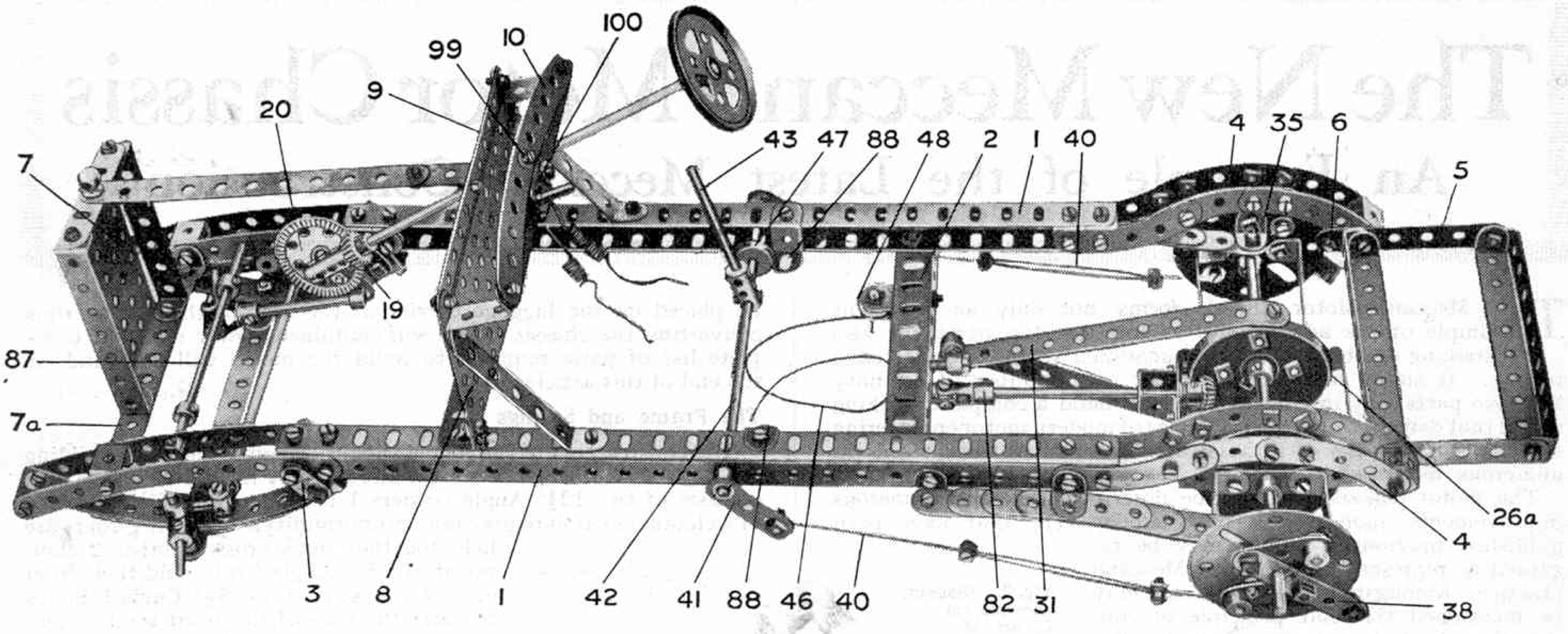


Fig. 2. Frame, showing Springs, Steering Column, and Rear Axle unit with Differential removed

to the Plate 8 by means of two 1″ Reversed Angle Brackets. The outer ends of these Brackets should be bent slightly to obtain the correct angle for the dashboard.

It will be seen clearly from Fig. 6 that the front springs are of the semi-elliptic type, and that each consists of one 5½″, one 4½″, one 3½″, one 2½″, and one 1½″ Strip placed one upon the other and slightly bent. Each end of the 5½″ Strip is secured to a Double Bracket. The rear Double Bracket is bolted pivotally (S.M. 262) to the pair of Flat Brackets 3, which form the shackles by means of which the rear ends of the springs are attached pivotally to the frame. The front Double Bracket is mounted on a ¾″ Bolt passing through the side frame members (Fig. 4).

The rear springs are of the cantilever type. Each spring is built up from the same components as the front springs and is attached rigidly to the frame by two Angle Brackets (see Fig. 2).

Principles of Ackermann Steering

It has already been mentioned that the steering gear is based on the Ackermann principle but the importance of the different angularities of the front wheels may be a point that has escaped the notice of many Meccano boys. Perhaps it will not be out of place, therefore, to insert here a brief summary of the principle of the gear.

When a car turns a corner the near side road wheels describe a sharper curve than the outer wheels. This will be clear on reference to Fig. 3. The drawing is intended to represent a car turning a corner, and in doing so it will be apparent that the wheels must describe an arc or portion of a circle whose centre is shown at A. Now although both front wheels must turn about this centre they are situated at varying distances from it. This means to say that the right-hand front road wheel must follow an arc having a radius equal to AB, and the left-hand wheel must follow an arc struck from a larger radius AC. For the wheels to describe an arc of a circle with the least possible friction on the road surface, each must be situated at a tangent to its respective circle. But it is obvious that both wheels cannot lie at their respective tangents and at the same time remain parallel to each other.

Hence it becomes necessary to incorporate in the steering gear some method by means of which a greater angle can be given to the wheel that is nearest to the centre of the circle, no matter whether the car be turning to right or left. The arrangement by which this object is achieved constitutes what is known as Ackermann steering gear. In actual practice, the gear consists essentially of two short levers rigidly connected to the stub axles and projecting either forward or backward. These levers lie at a slightly obtuse angle to the stub axles. The correct angle is arrived at by fixing the levers so that their centre lines, if produced, would meet on the centre line of the car. The exact meeting place varies according to the size of the car and length of the levers, but as a rule it is found to be just in front of the back axle. The levers are connected one to the other by a tie rod.

The Chassis Steering Gear

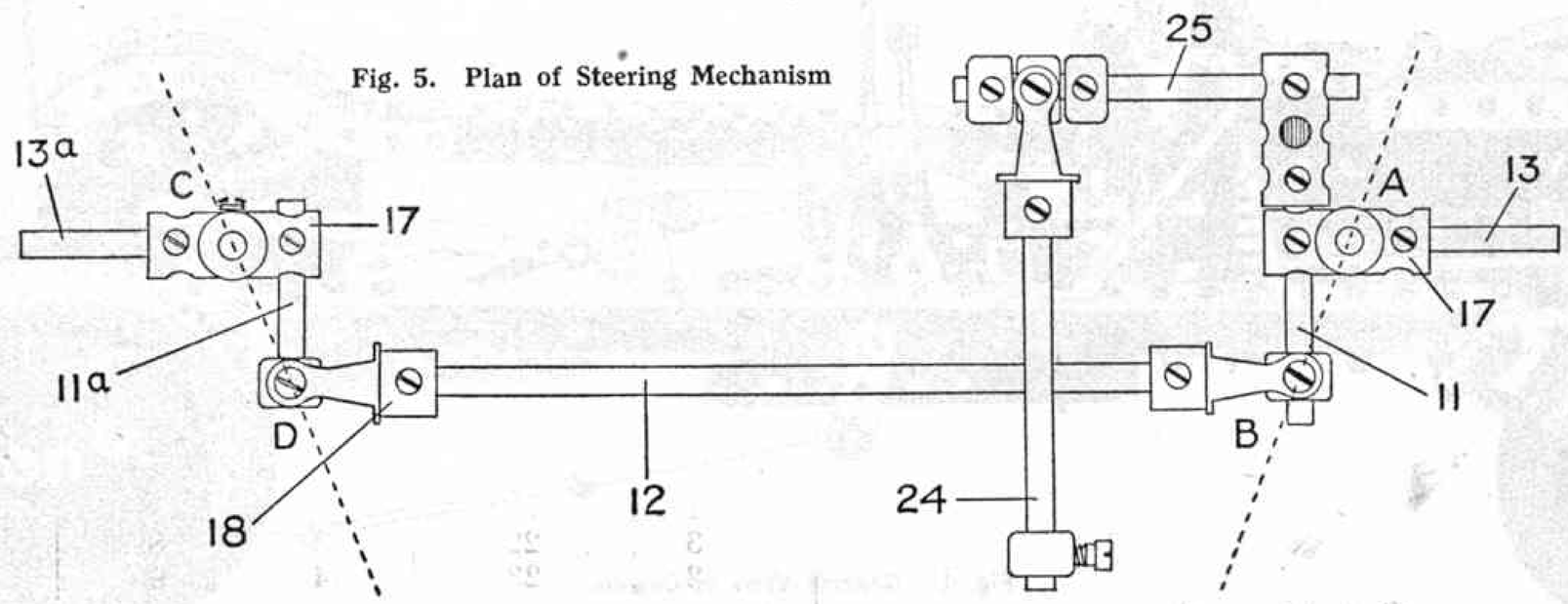
In Meccano practice it has been found a little difficult to secure the necessary angles in the levers and at the same time maintain a perfectly rigid construction, and therefore, a slightly different method has been adopted. This comprises short Rods 11 and 11a (Figs. 4 and 5) secured just behind the stub axles and protruding backward. They are connected together by a 5″ Rod 12. A plan view of this linkage is shown in Fig. 5, and it will be seen from the drawing that imaginary lines AB, CD drawn through the pivotal mountings of the stub axles and through the points where the tie rod 12 is attached to the rods 11 and 11a correspond roughly to the angles at which the levers would be placed in actual practice.

Now if the car is to be turned to the right when looking at the gearing as in Fig. 5, the road wheel on the stub axle 13 must be deflected in that direction and the imaginary lever AB will be moved through a certain number of degrees to the left. In doing so it pushes the lever corresponding to CD in our sketch in the same direction, but owing to the difference in angularity between the two levers, lever CD and therefore the road wheel attached to its stub axle 13a, moves through a lesser number of degrees. If the car moves to the left exactly the opposite occurs, the lever CD moving through a greater number of degrees than the lever AB.

Therefore this arrangement of the linkage fulfils the essential requirements of the Ackermann steering gear, that is, it imparts a greater angular movement to the inner road wheel when the car turns a corner.

The mounting of the stub axle 13a is shown in detail in Fig. 6. The fixed front axle 14 consists of two 5½″ Strips overlapped two holes and supporting at each end a Crank 15. A 1½″ Axle Rod 16 secured in each Crank 15 serves as a vertical swivel pin upon which a Coupling 17 carrying the stub axle (a 1″ Axle Rod) is free to turn. The Coupling 17 in Fig. 6 carries the 1″ Rod 11a, to which is secured a Swivel Bearing 18 (Part No. 165).

Fig. 5. Plan of Steering Mechanism



The fork of the latter is fixed to the tie rod 12, the other end of which is connected to the other stub axle by another Swivel Bearing secured to the 1½″ Rod 11 (Figs. 4 and 5).

The connections between the steering wheel and the road wheels form another important point that must be considered in connection with the steering gear. The gear ratio, or extent of movement of the road wheels to a given movement of the steering wheel, must not be too high, otherwise a slight twist of the wheel would result in a considerable deflection of the car, which would be dangerous and might easily cause accidents. On the other hand, if the ratio is too low the car would be slow to respond to the wheel and therefore difficult to manage in dense traffic. In actual practice the gear reduction is effected in various ways, principally by worm and nut mechanism, but in the Meccano model the most convenient method was found by gearing a ½″ Bevel 19 with a 1½″ Bevel Wheel 20, Fig. 4. The latter is free to turn on a 1½″ Rod journalled in the side frame member and secured in the centre of a Coupling 21. One end of this Coupling forms a journal bearing for the end of the steering column 22, which consists of an 8″ Rod carrying a 2″ Pulley Wheel to represent the steering wheel.

A Flat Bracket 23 bolted to the 1½″ Bevel Wheel 20 forms the steering lever, and a set-screw passed through its elongated hole is used to secure a Collar to the 2½″ Rod 24. The other end of this Rod 24 carries a Swivel Bearing, the collar of which is free to turn between two Collars and set-screws on the 2″ Rod 25. Nuts should be placed on the bolts against the collar of the Swivel Bearing, to hold the bolts rigid without gripping the Rod 25. The latter rod is fixed in a Coupling secured to the 1½″ Rod 11. It will now be seen that the movement of the steering wheel is transmitted to the right-hand road wheel via the Bevel Wheel 20 and linkage 24 and 25, and the left-hand wheel is caused to move simultaneously but at a different angle, as has been explained already, by means of the Rods 11 and 11a and tie rod 12.

The fixed front axle 14 is secured to the front chassis springs by means of ⅜″ Bolts. The Cranks 15 should be bent so that the fixed swivel pins 16 are slightly out of the vertical, with their upper ends pointing outward. This brings the points of contact between the front wheels and the ground as nearly as possible beneath the centres of the swivel pins. In actual practice the object of canting the swivel pins in this way is to save the driver from fatigue and road shock, for if the centre line of each road wheel was parallel with the centre line of the swivel pin, all shock or vibrations in the road wheel would act on the steering wheel with a leverage equal to the distance that separates them. It is specially important in cars fitted with four-wheel brakes, for the application of such brakes on a car where pin and wheel are parallel would tend to " toe out " the wheels.

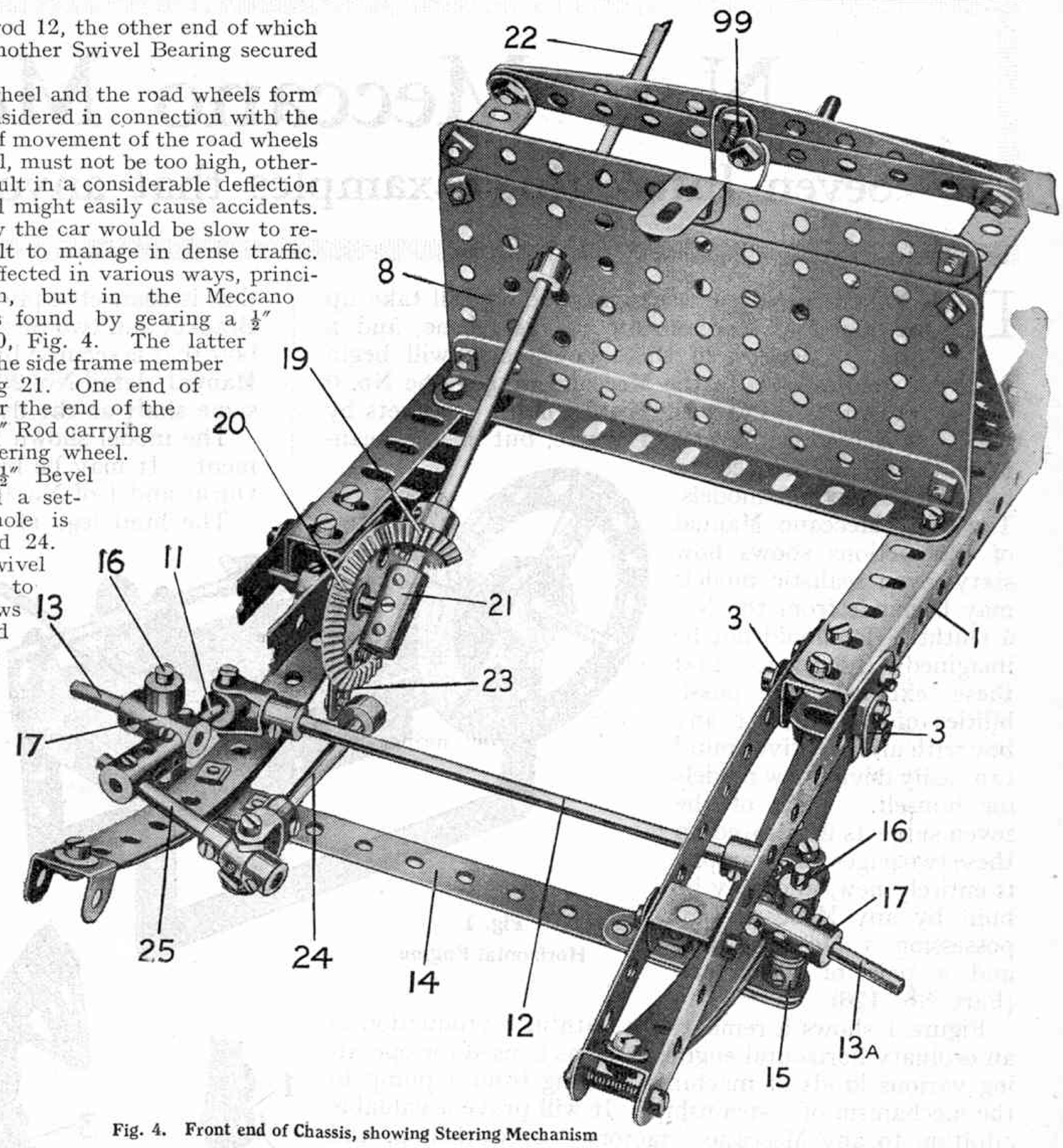


Fig. 4. Front end of Chassis, showing Steering Mechanism

The instructions for building the New Motor Chassis will be concluded in next month's "*M.M.*" The second instalment of the article will describe the back axle unit, the transmission gear and differential, etc.

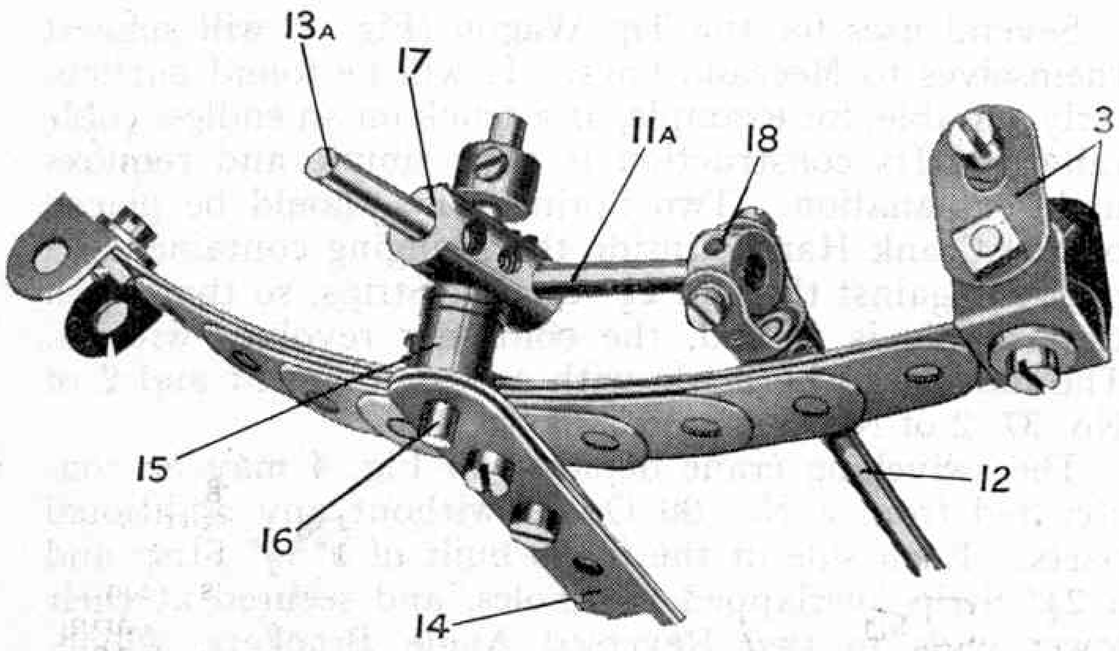


Fig. 6. Detail of Left-hand Stub Axle

Parts Required

The following is a complete list of the parts required to build the revised Motor Chassis :—

11	of No.	2	1	of No.	23A	2	of No.	90A
9	„ „	2A	2	„ „	25	4	„ „	101
4	„ „	3	4	„ „	26	1	„ „	102
6	„ „	4	2	„ „	27	2	„ „	109
6	„ „	5	1	„ „	27A	5	„ „	111
9	„ „	6A	1	„ „	28	8	„ „	111A
4	„ „	8	4	„ „	30	9	„ „	111C
2	„ „	9	2	„ „	30A	1	„ „	115
12	„ „	10	2	„ „	30C	2	„ „	120B
8	„ „	11	4	„ „	31	4	„ „	124
24	„ „	12	178	„ „	37	2	„ „	125
4	„ „	12A	38	„ „	37A	2	„ „	126
4	„ „	12B	40	„ „	38	1	„ „	136
1	„ „	13A	1	„ „	45	4	„ „	137
2	„ „	14	2	„ „	46	5	„ „	140
2	„ „	15	2	„ „	47A	4	„ „	142B
1	„ „	15A	9	„ „	48A	2	„ „	147B
5	„ „	16	2	„ „	48B	1	„ „	157
2	„ „	16A	4	„ „	48C	2	6BA Screws	
1	„ „	16B	1	„ „	53	2	6BA Nuts	
5	„ „	17	1	„ „	55A	2	Insulating Bushes	
5	„ „	18A	3″	„ „	58			
3	„ „	18B	42	„ „	59	2	Insulating Washers	
4	„ „	19B	5	„ „	62			
1	„ „	20	9	„ „	63	1	Small Rubber Ring	
1	„ „	20A	1	„ „	70			
3	„ „	22	5	„ „	89	1	4-volt Electric Motor	
2	„ „	23	14	„ „	90			

New Meccano Models

Seven Interesting Examples that anyone can Build

DURING the next few weeks many boys will take up the hobby of Meccano for the first time, and a large proportion of these newcomers will begin with the smallest sets in the Meccano range—the No. 0 or No. 00 Outfits. Later they will enlarge their sets by means of Accessory Outfits, of course, but in the meantime they can proceed to build some very fine models. The 1927 Meccano Manual of Instructions shows how sixty-seven realistic models may be made from the No. 0 Outfit. It should not be imagined, however, that these exhaust the possibilities of the set, for any boy with an inventive mind can easily devise new models for himself. Each of the seven subjects illustrated on these two pages, for example, is entirely new, and may be built by any Meccano boy possessing a No. 0 Outfit and a pair of Trunnions (Part No. 126).

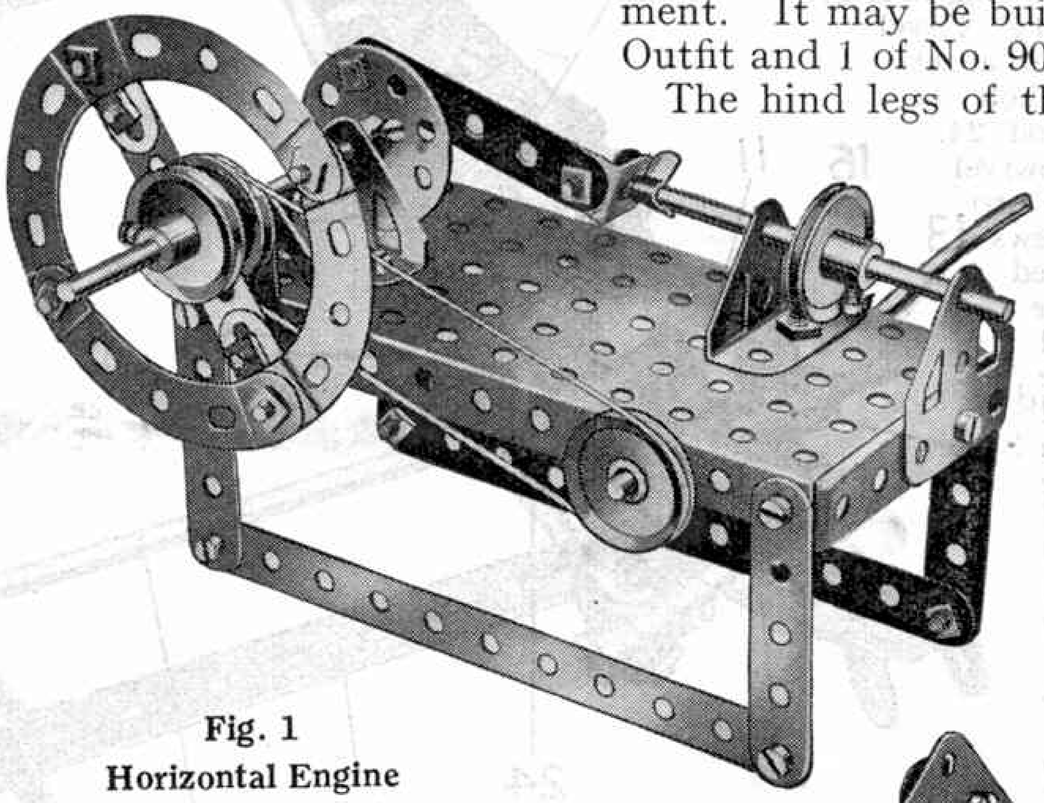


Fig. 1
Horizontal Engine

Figure 1 shows a remarkably faithful reproduction of an ordinary horizontal engine, such as is used for operating various kinds of machines ranging from a pump to the mechanism of a steamship. It will prove a valuable addition to any Meccano "factory" or workshop, and can easily be built from a No. 00 Outfit and the following extra parts :—1 of No. 37, 4 of No. 90a, and 2 of No. 126.

The flywheel is built up of four $2\frac{1}{2}$" Curved Strips bolted together to form a circle and secured to a $2\frac{1}{2}$" Strip by means of two Flat Brackets. It is mounted on a $3\frac{1}{2}$" Rod that is journalled in one ordinary Trunnion and one Flat Trunnion secured to the $5\frac{1}{2}$" × $2\frac{1}{2}$" Flanged Plate that forms the bed of the engine. The flywheel is held rigid on its Rod by means of two 1" Pulleys secured one on each side of the $2\frac{1}{2}$" Strip. One of these Pulleys is designed to take a belt to another machine, while the other takes the drive from a third 1" Pulley fastened to the Crank Handle. The piston (a 1" fixed Pulley Wheel) and the piston rod are actuated by a $2\frac{1}{2}$" Strip that is connected pivotally to the piston rod by an Angle Bracket and two Spring Clips, its other end pivoting on a bolt that is secured by two nuts (see Standard Mechanism Manual, detail No. 262) to a Bush Wheel mounted on the same shaft as the flywheel.

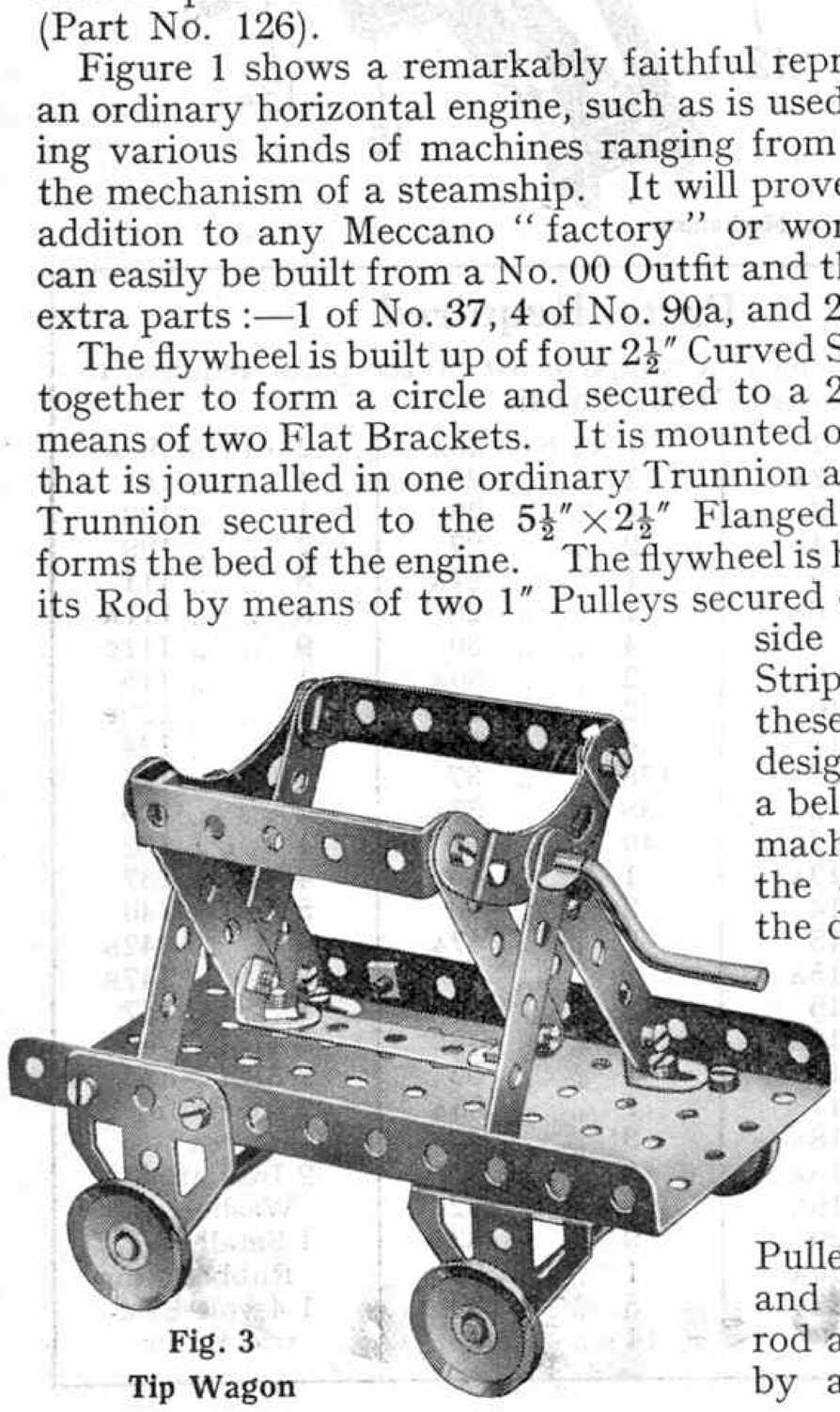


Fig. 3
Tip Wagon

The model shown in Fig. 2 will afford endless amusement. It may be built by any one possessing a No. 00 Outfit and 1 of No. 90a and 1 of No. 126.

The hind legs of the "prancing horse" are secured rigidly to the base-plate, and the $2\frac{1}{2}$" Strip 1 is attached to them by means of a Bolt 2 carrying two nuts, one on each side of the Strips forming the legs. A clearer view of this portion of the model is shown in Fig. 2a. The Strip 1 must be free to pivot on the shank of the Bolt 2. Rotation of the Crank Handle, which is journalled in Angle Brackets mounted on two Reversed Angle Brackets, causes the Bush Wheel in the foreground of the illustration to actuate the foreleg 3, and the horse will begin to prance in a most lifelike manner, in spite of the fact that he has only three visible legs!

Fig. 2a

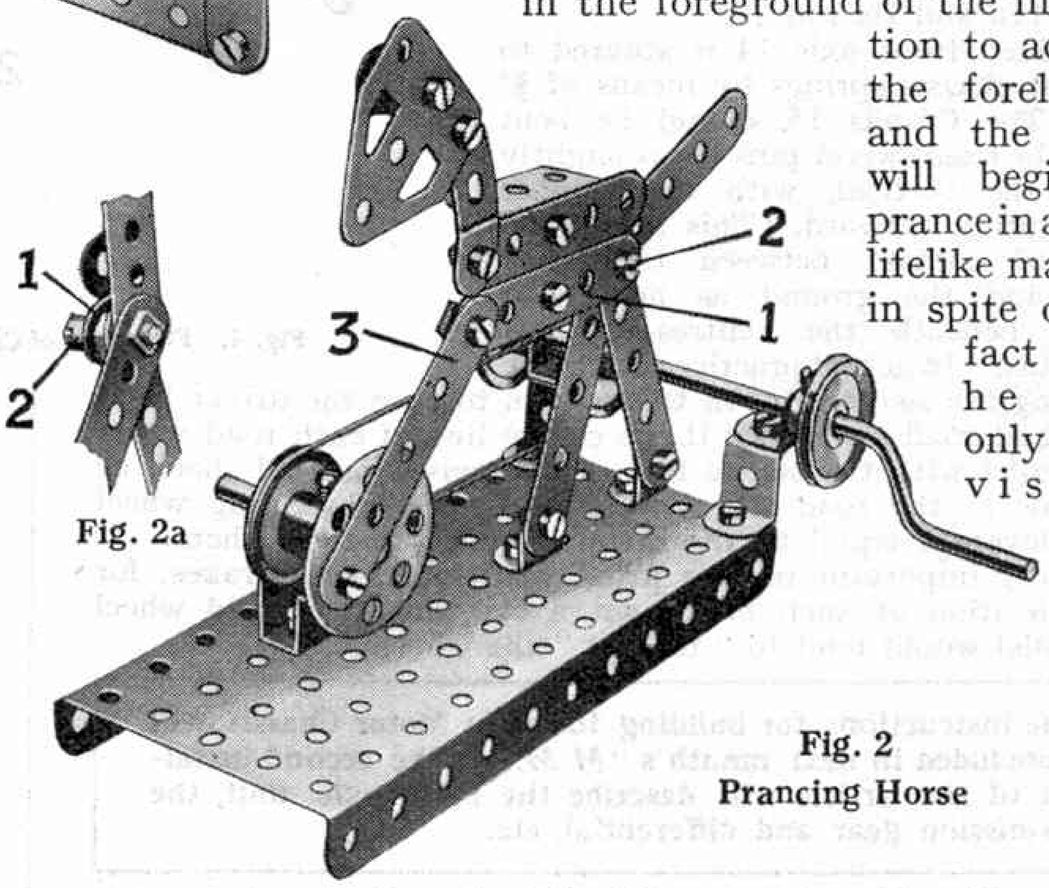


Fig. 2
Prancing Horse

Several uses for the Tip Wagon (Fig. 3) will suggest themselves to Meccano boys. It will be found particularly suitable, for example, as a truck on an endless cable railway. Its construction is very simple and requires little explanation. Two Spring Clips should be placed on the Crank Handle inside the swinging container and pressed against the end $2\frac{1}{2}$" Curved Strips, so that when the Handle is turned, the container revolves with it. The model can be made with a No. 00 Outfit and 2 of No. 37, 2 of No. 90a, and 2 of No. 126.

The swivelling crane depicted in Fig. 4 may be constructed from a No. 00 Outfit without any additional parts. Each side of the jib is built of a $5\frac{1}{2}$" Strip and a $2\frac{1}{2}$" Strip overlapped two holes, and secured at their lower ends to two Reversed Angle Brackets, which, in turn are bolted to a Double Bracket. The latter is

attached pivotally to the bed-plate by a bolt and lock-nuts. A 3½″ Axle Rod is journalled through a 2½″×½″ Double Angle Strip in the vertical member and is maintained in position by a 1″ fixed Pulley. This Rod also passes through a Flat Bracket connected to the tops of the tie-members, each of which is composed of a 5½″ Strip and a 2½″ Strip bolted end to end.

The Dump Cart illustrated in Fig. 5 is similar in functions, though not in form, to the Tip Wagon (Fig. 3). The model as shown is built with a No. 00 Outfit and one 2½″ Curved Strip (No. 90a), but the latter may be omitted if desired. The sides of the chassis are formed by two pairs of 2½″ Strips overlapped three holes and bolted at the forward end to two upright 2½″ Strips and joined by a 2½″×½″ Double Angle Strip. Two Reversed Angle Brackets form rests for the end of the 5½″×2½″ Flanged Plate, which represents the pivoting body of the cart.

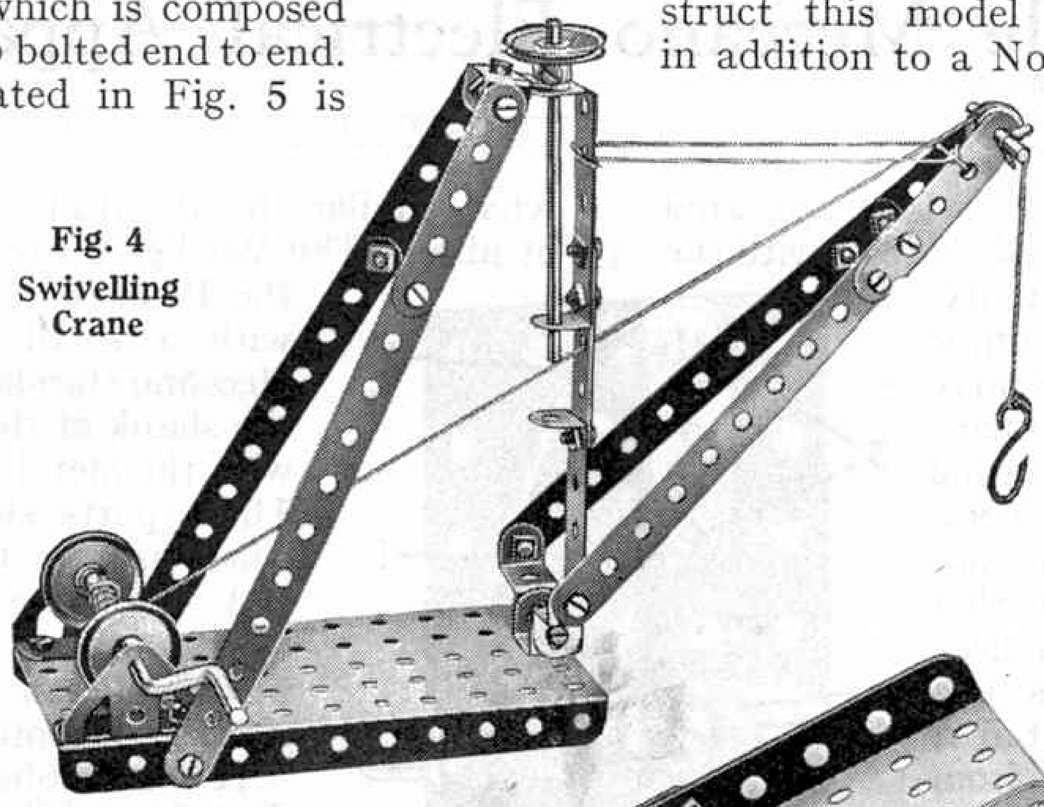


Fig. 4 Swivelling Crane

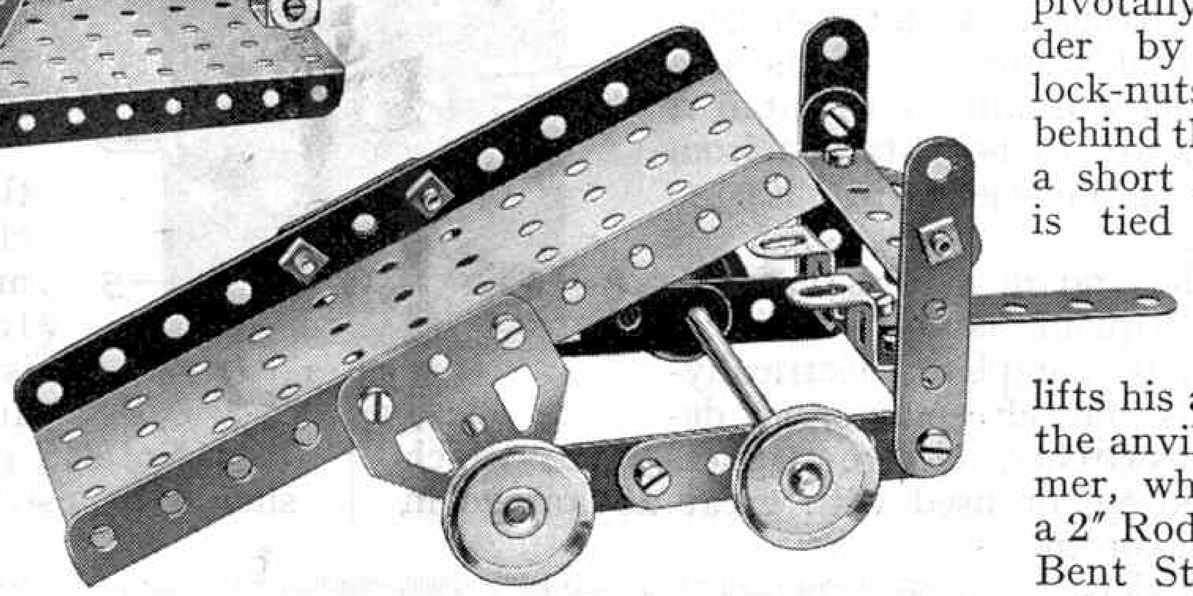


Fig. 5 Dump Cart

Few people would think it possible to construct a working model of a lathe from any but the bigger Meccano Outfits, yet here is one (Fig. 6) which can be built with Outfit No. 0, or No. 00 with the following extra parts :—2 of No. 11, 1 of No. 12, and 2 of No. 126. Not only is the lathe very realistic in appearance, but it may actually be used to turn objects out of any soft substance, such as wax or plasticine.

Very little description is necessary to explain the construction of the model. It will be seen that the Crank Handle carries a fixed Pulley, and a length of cord passes round the latter and over a similar Pulley secured to a 2″ Axle Rod journalled in two Trunnions bolted to the horizontal 5½″ Strip. The rod carries at one end a Bush Wheel, which serves to hold the objects to be turned. The tool-holder consists of two Double Brackets bolted together and secured to the upper side of the 5½″ Strip. In order to obtain a better "grip" on the transmission belt it may be found advantageous to cross it, or even to give it a complete turn around each pulley.

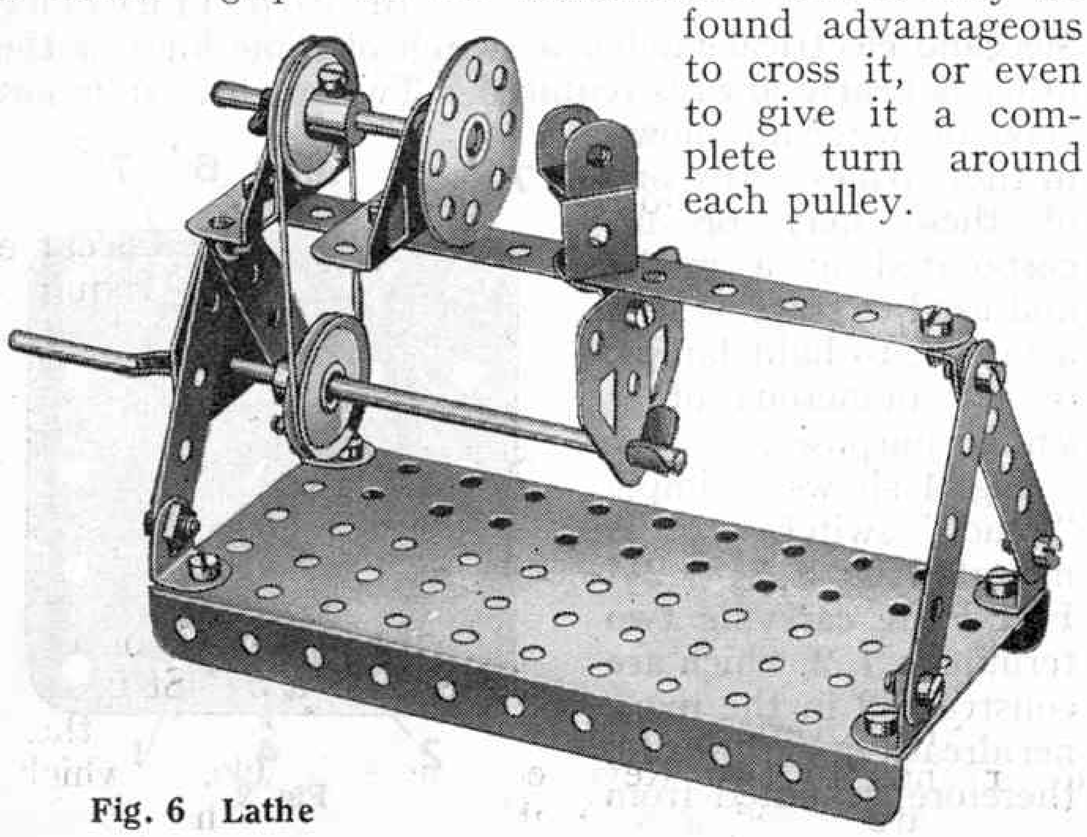


Fig. 6 Lathe

The stalwart blacksmith shown in Fig. 7 certainly lives up to the reputation of his trade, for the muscles of his brawny arms are literally "strong as iron bands"! He may be made in a few minutes and when constructed, he will provide a good deal of amusement. To construct this model the following parts are necessary in addition to a No. 00 Outfit :—2 of No. 37, 2 of No. 90a, and 2 of No. 126.

Two Flat Trunnions form the blacksmith's body, and his legs (2½″ Strips) are firmly bolted by means of Angle Brackets to the floor of the smithy, or to be more correct, to the 5½″×2½″ Flanged Plate. His face is a 1″ Pulley Wheel, his neck a Flat Bracket, and his left arm a 2½″ Curved Strip. His right arm (a 2½″ Strip) is attached pivotally to the shoulder by a bolt and lock-nuts and projects behind the figure, where a short length of cord is tied to it. When this cord is jerked, the blacksmith lifts his arm and smites the anvil with his hammer, which consists of a 2″ Rod and a Cranked Bent Strip, as shown.

It will be noticed that reference is frequently made in this and other articles to Standard Mechanism No. 262, and for the benefit of those readers who are unable to consult the Meccano Standard Mechanisms Manual, we may say that this particular "S.M." consists of a simple type of pivot, or swivel bearing, formed by a bolt and two nuts. The bolt is secured rigidly to a Strip or Plate, etc., by means of the nuts, which are screwed tightly against opposite sides of the Strip, sufficient spacing being left beneath the head of the bolt to permit another Strip to turn freely about its shank.

A somewhat similar form of swivel-joint, also widely used, consists of a bolt and lock-nuts (S.M. 263). The two Strips to be connected pivotally are placed on the bolt and held in position by two nuts locked together on the shank. The Strips must be allowed a certain amount of play so that they can pivot independently about the bolt. These pivoting devices will be found equally valuable in the simplest and the most elaborate models.

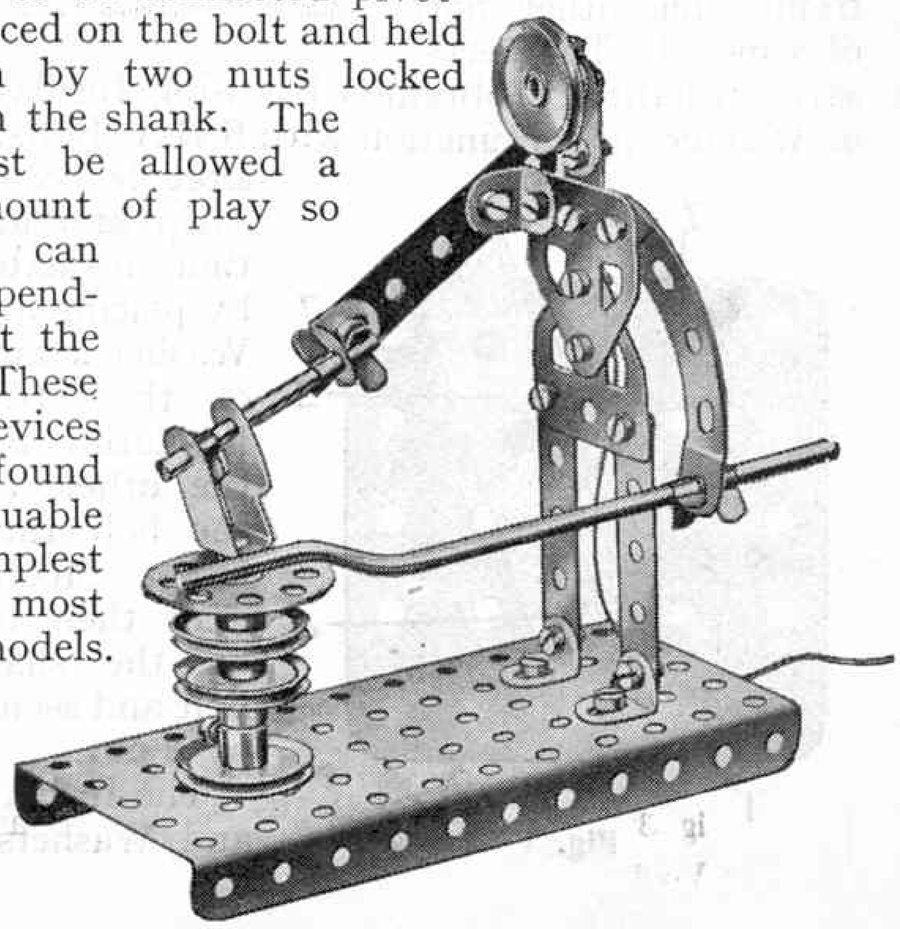


Fig. 7 The Meccano Blacksmith

Electricity Applied to Meccano

III.—Simple Meccano Electrical Apparatus

THE preceding articles in this series, which appeared in the last two issues of the "*M.M.*," dealt with the elementary principles of electricity, and in this article we describe some simple but very interesting apparatus that may be constructed by combining the ordinary Meccano parts with the special Meccano electrical accessories. We would recommend every Meccano boy who has not already done so to read the two earlier articles before starting work on the models, since a rudimental knowledge of the elements of electricity is almost essential if the best results are to be obtained from the application of the science to Meccano model-building.

In this article, and in others that will appear in subsequent issues, we shall describe not only complete electrically-operated models but also numerous devices, such as switches, electro-magnets, etc., which may be adapted to, or used with great advantage in connection with, ordinary Meccano models.

A list of Meccano electrical parts is included on this page. These parts may be obtained separately and used in conjunction with the ordinary Meccano accessories, for which purpose they are specially designed.

In constructing Meccano electrical apparatus it will frequently be necessary to insulate a Strip or Plate, etc., from some other part of a model. The necessary insulation is obtained by using Insulating Bushes or Washers in conjunction with 6 B.A. Bolts. A 6 B.A. Bolt is secured to the Strip and at the same time insulated from it by placing an Insulating Washer against one side of the Strip and an Insulating Bush against the other, and passing the bolt through both. Other Meccano pieces may then be mounted on the shank of the bolt and secured in place by a nut.

Fig. 1

The Insulating Bushes and Washers are somewhat similar in appearance and both are constructed of fibre. The Washer, however, is of a red colour while the Bush is black, and the latter is fitted with a small ridge which fits inside a Meccano standard hole, thereby preventing the shank of the bolt from making contact with the metal part to which it is attached. These parts should always be employed when using a 6 B.A. Bolt.

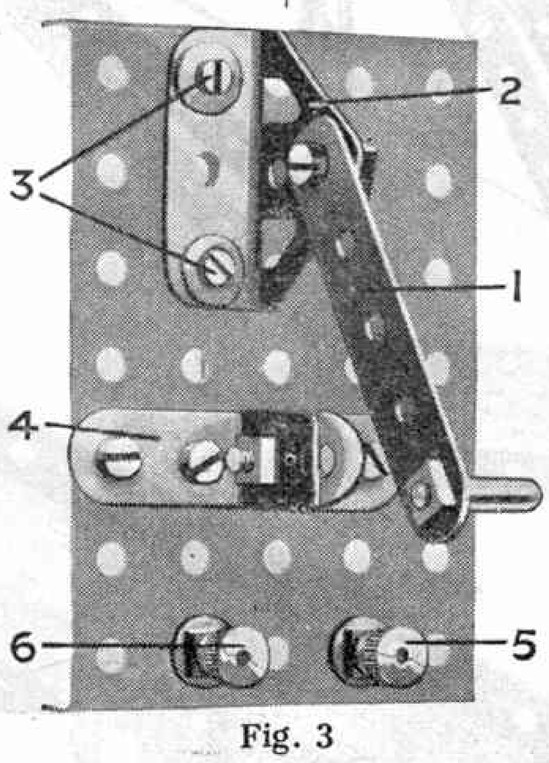


Fig. 3

A complete terminal is constructed by mounting a 6 B.A. Bolt in the manner described and threading on its shank a Meccano Terminal (part No. 306).

It will be observed from the list of parts that four different kinds of wire are included in the electrical accessories. The first of these (part No. 312, 27 Gauge Bare Iron Wire) is of a very high resistance and is intended for use in constructing resistance controllers or speed regulators, etc. Part No. 313 (26 Gauge Cotton Covered Copper Wire) should be used for winding bobbins to form electro-magnets, etc., and part No. 314 (23 Gauge Cotton Covered Copper Wire) is intended for all ordinary connecting purposes. The 22 Gauge Bare Copper Wire (Part No. 315) is designed for use on the few occasions when it is desired to transmit current over an exposed wire, such as in the case of an overhead wire for tramway or locomotive models.

MECCANO ELECTRICAL PARTS

				s.	d.
Part No.	301.	Bobbin	each	0	4
,, ,,	302.	Insulating Bush	doz.	0	6
,, ,,	303.	Insulating Washer	,,	0	3
,, ,,	304.	6 B.A. Screws	,,	0	6
,, ,,	305.	6 B.A. Nuts	,,	0	3
,, ,,	306.	Terminal	each	0	1
,, ,,	307.	Silver-tipped Contact Screw	,,	0	5
,, ,,	308.	Core or Pole Piece	,,	0	3
,, ,,	309.	Coil Cheek	,,	0	3
,, ,,	310.	Lamp Holder	,,	0	3
,, ,,	311.	Best Metal Filament Lamp	,,	0	6
,, ,,	312.	27 Gauge Bare Iron Wire, per length of 30"		0	1
,, ,,	313.	26 Gauge SCC Copper Wire, Reels of 50 yds.		2	3
,, ,,	314.	23 Gauge SCC Copper Wire, ,, 25 ,,		2	0
,, ,,	315.	22 Gauge Bare Copper Wire, ,, 4 ,,		0	3

Meccano Switches

In constructing Meccano electrical models a switch of some kind or the other is nearly always required. Two or three different types of switch are shown in these pages. Any one of these may be incorporated in a model and used to start or stop a motor, to light lamps, or for numerous other similar purposes.

Fig. 1 shows a simple "stud" switch. It is mounted on a $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plate carrying two terminals, 1, 2, which are constructed in the manner already described and, therefore, insulated from

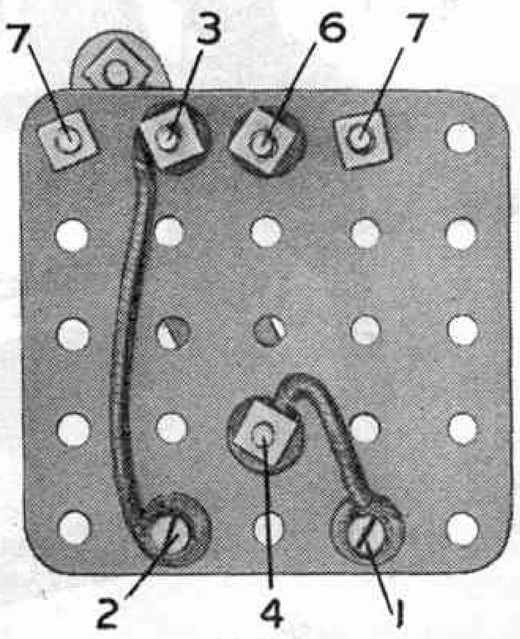


Fig. 2

the plate. The terminal 2 is connected by an insulated wire to a 6 B.A. Bolt 3 that is insulated from the plate by a Bush and Washer (see rear view of switch, Fig. 2), while the terminal 1 is connected to the 6 B.A. Bolt 4. The latter is also insulated from the plate and carries the $2\frac{1}{2}$" Strip 5 forming the switch arm. The Strip 5 is spaced from the plate by a nut placed beneath it on the shank of the bolt, and a metal Washer should be placed beneath the head of the bolt to ensure proper contact with the Strip. The nuts on the bolt 4 should be adjusted so that the switch arm 5 moves stiffly. A Threaded Pin secured to the end of the Strip 5 forms a convenient handle and two $\frac{3}{8}$" bolts 7, secured by a nut placed on each side of the plate, act as stops. A second insulated 6 B.A. Bolt 6 is mounted in the position shown ; this is not connected electrically, since it merely forms a rest for the switch arm when the switch is placed in the "off" position.

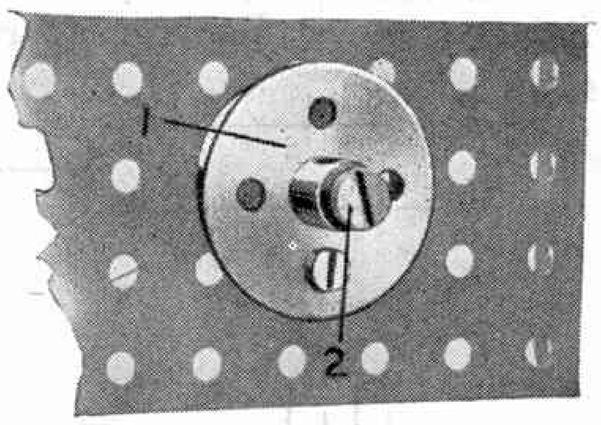


Fig. 4

When the arm 5 is placed over the bolt 3 the circuit is completed, for the current is able to flow from the terminal 2 through the switch arm and back to the terminal 1 via the bolt 4 and short length of wire connected to it. One of the terminals 1, 2 should be connected to the Accumulator and the other terminal to tne Motor or lamp, etc., which it is desired to control. The remaining connections consist, of course, of a wire from the second Accumulator terminal to the second terminal of the Motor or lamp. The appearance of the switch will be improved if small labels are pasted beneath the bolts 3 and 6 to indicate the "on" and "off" positions of the switch arm.

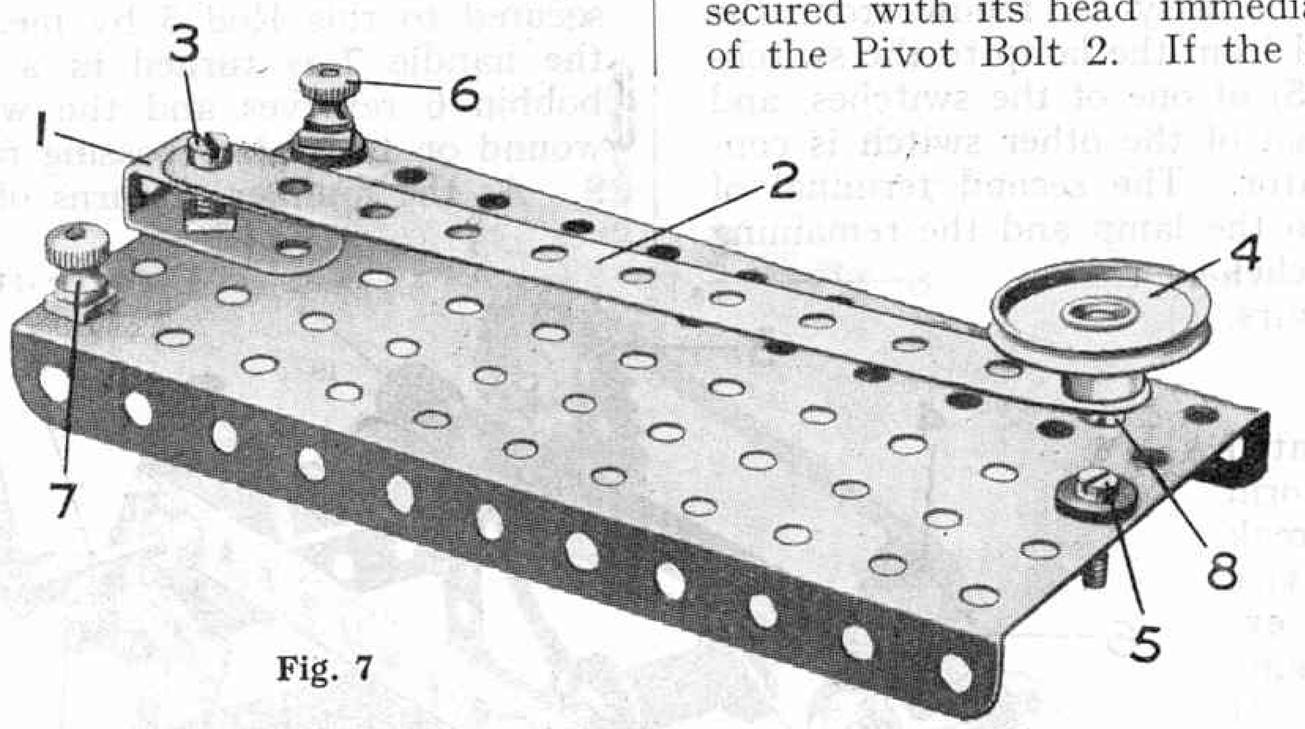


Fig. 7

Another type of switch having exactly the same functions as that just described is shown in Fig. 3. This type is known as a knife switch, since the circuit is completed by forcing a thin blade-like lever between a forked contact piece. An important advantage of this switch lies in the fact that the contact surfaces are kept always clean by reason of the scraping action caused by thrusting the switch arm into its place.

The arm 1 in this switch is pivoted by bolt and lock-nut (see Standard Mechanism No. 263) to a Trunnion 2, which is insulated from the base of the switch by means of Insulating Bushes and Washers placed on the two 6 B.A. Bolts 3. The contact piece consists of two $1" \times 1"$ Angle Brackets 4 bolted to the base plate (a $3\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plate) and having their protruding ends slightly bent as shown in order to grip the switch arm more readily. The terminal 5 is threaded on a 6 B.A. Bolt insulated from the base and connected by a piece of covered wire to one of the bolts 3 ; the second terminal 6 is connected by another piece of wire to one of the bolts securing the Angle Brackets 4 to the Flanged Plate. The connections to the Motor, etc., that it is desired to control are similar to those in the switch first described.

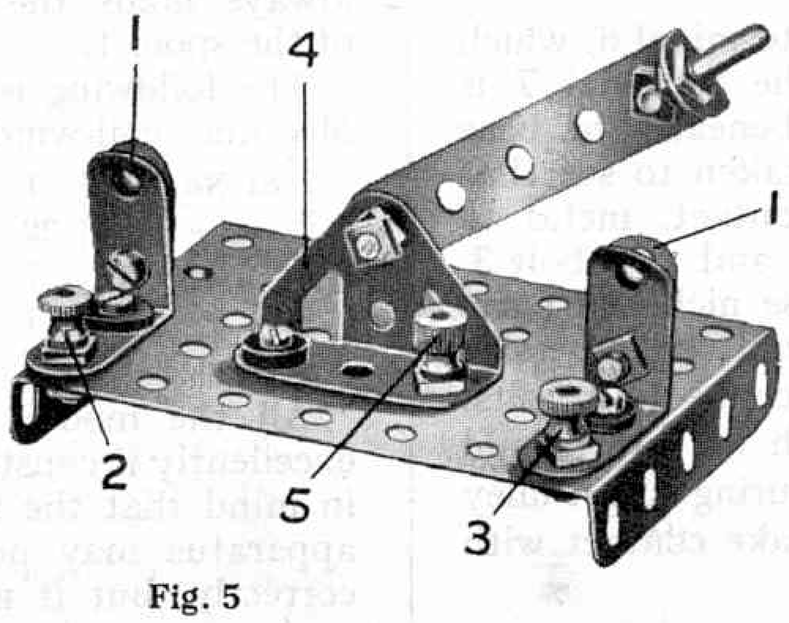


Fig. 5

Push-Button Switch

A remarkably neat Meccano switch is shown in Fig. 4. This is of the push-button type and may be used in connection with electric bells, buzzers, flash lights, etc., as well as in innumerable Meccano models. It consists essentially of a Flanged Wheel 1 and Pivot Bolt 2. A small compression spring, obtained by cutting two or three turns off part No. 120b (Spring for Spring Buffer), is placed between the head of the bolt and the boss of the wheel. The contact piece consists of a 6 B.A. Bolt secured with its head immediately beneath the shank of the Pivot Bolt 2. If the switch is mounted on a metal base as in the illustration the contact bolt must be insulated, of course, by means of fibre Bushes and Washers.

In making the connections, one wire should be secured to the $\frac{1}{2}$" bolt holding the Flanged Wheel in place and another to the insulated contact bolt. The circuit is completed by pressing down the Pivot Bolt, which is prevented from falling out of position by a nut placed on its extreme inner end.

Two-Way Switch

Yet another type of switch is shown in Fig. 5. This is a two-way switch, and is designed to complete one or other of two separate circuits. The contact pieces 1 are formed from Flat Brackets secured to $1" \times 1"$ Angle Brackets, which are insulated from the base plate in the usual manner. The tops of the contact pieces are bent slightly, as may be seen in the illustration, to facilitate engagement with the switch arm.

The terminals 2 and 3 are mounted on 6 B.A. Bolts passed through the base plate and the $1" \times 1"$ Angle Brackets, an Insulating Washer being placed on the shank of each bolt, of course, between the plate and the brackets. It will be noticed that the nuts beneath the terminal caps are pressed against the $1" \times 1"$ Angle Brackets, so that the latter are in direct contact with the terminals. The switch arm consists of a $2\frac{1}{2}$" Strip pivoted by means of bolt and lock nuts (S.M. 263) to a Trunnion 4, which is also insulated from the base plate. The terminal 5 is mounted in exactly the same way as the others.

The functions of a switch of this type should be clear on reference to the diagram (Fig. 6). The drawing is intended to represent two-way switches arranged to control

an electric light from two different points. A circuit similar to this is frequently used to control a light over the staircase in electrically-equipped houses, where the lamp may be switched on from the foot of the stairs and put out again from a second switch at the top, or vice versa. The circuit is extremely simple and we have little doubt that Meccano boys will find numerous uses for it. It is equally applicable, of course, to the control of an Electric Motor.

It will be seen that two switches, each exactly the same, are required. In the diagram the lamp is shown "off," but operation of either switch will cause it to be illuminated. Similarly, if the lamp is on, movement of either switches will extinguish it. The wiring connections will be easy to follow from the diagram ; one wire is led from the lamp to the switch-arm terminal (5 in Fig. 5) of one of the switches, and the corresponding terminal of the other switch is connected to the Accumulator. The second terminal of the latter is connected to the lamp and the remaining terminals 2, 3 on the switches are wired together in pairs.

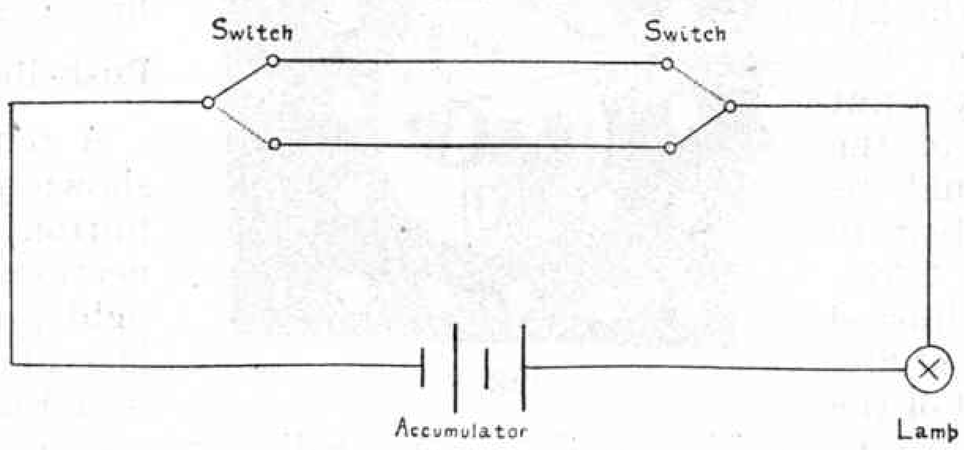


Fig. 6

Meccano Tapper

The tapper key illustrated in Fig. 7 is designed to form a simple make-and-break contact apparatus. A device of this kind will prove extremely useful when making electrical experiments. It consists of a $5\frac{1}{2}'' \times 2\frac{1}{2}''$ Flanged Plate, to which a Single Bent Strip 1 and a $5\frac{1}{2}''$ Strip 2 are directly attached by a $\frac{3}{4}''$ Bolt 3. A convenient knob is formed by a 1" Pulley Wheel 4 secured by its set-screw to the shank of a $\frac{3}{4}''$ Bolt 8 passed through the end of the $5\frac{1}{2}''$ Strip 2.

The contact piece consists of a 6 B.A. Bolt and nut 5 insulated from the plate and connected by an insulated wire to the terminal 6, which is also insulated from the plate. The terminal 7 is connected by another length of wire beneath the base plate to the bolt 3. Care should be taken to see that the Strip 2 makes good electrical contact, metal to metal, with the Single Bent Strip 1 and the bolt 3, and in such cases it is advisable to use nickelled parts in preference to coloured ones, to avoid the necessity of removing the enamel around the connecting bolts. If enamelled Strips are used, a length of wire should connect the bolt 3 to the bolt 8 securing the Pulley Wheel 4, since the latter bolt must make contact with the stud 5.

Coil-Winding Machine

Fig. 8 shows a coil winder. This apparatus is devised specially for winding insulated wire round the Meccano Bobbins, part No. 301, when constructing electro-magnets, etc. The model is very simple and may be constructed in a few minutes. When complete it will wind the Bobbin quickly and evenly, thus obviating the tedious process of laying on the wire by hand.

The spool of wire 1 is mounted loosely on the $4\frac{1}{2}''$ Rod 2, to which is secured a 2" Sprocket Wheel 3. The latter is connected by chain to a 1" Sprocket Wheel 4 secured to the $3\frac{1}{2}''$ Threaded Rod 5. The Meccano Bobbin 6 is secured to this Rod 5 by means of two nuts. When the handle 7 is turned in a clockwise direction, the bobbin 6 revolves and the wire from the spool 1 is wound on to it after passing round the 1" loose Pulley 8. As the number of turns of wire on the bobbin increases it will be found that the Pulley 8 slides along its Rod, thereby guiding the wire always in the correct position. Hence, once the bobbin is started, it is unnecessary to touch the wire by hand unless, of course, some accident occurs to upset the uniformity of the layers on the bobbins.

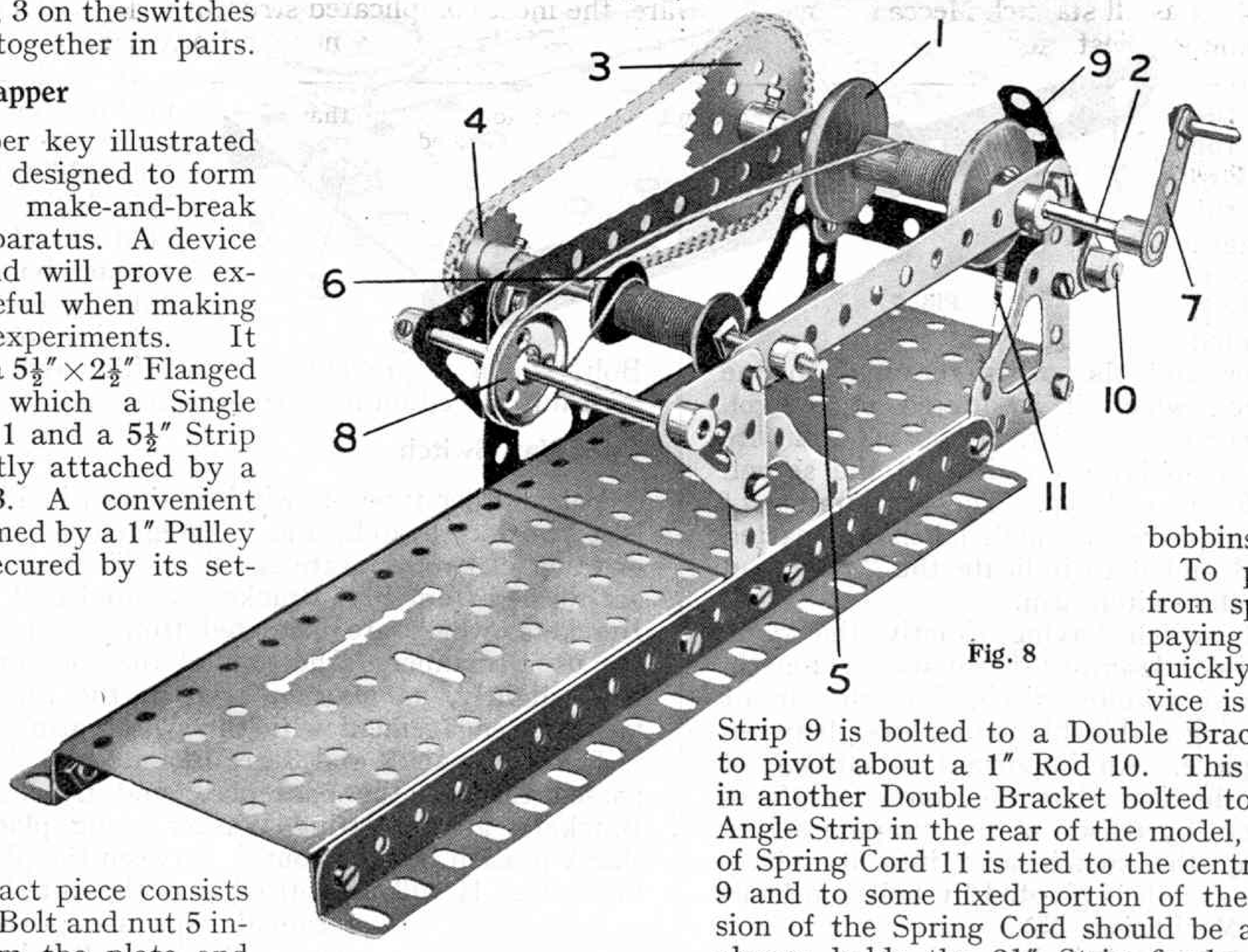


Fig. 8

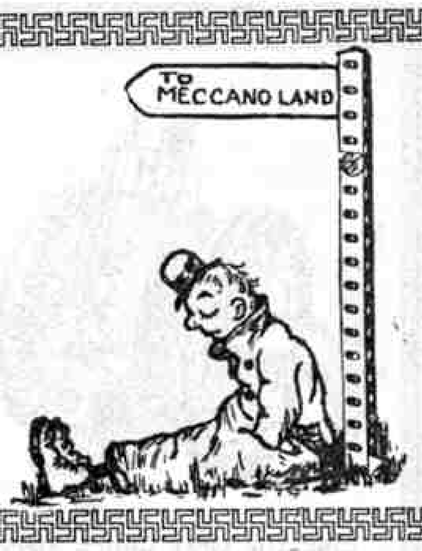
To prevent the spool from spinning round and paying out the wire too quickly, the following device is adopted. A $2\frac{1}{2}''$ Strip 9 is bolted to a Double Bracket, which is free to pivot about a 1" Rod 10. This Rod is journalled in another Double Bracket bolted to a $2\frac{1}{2}'' \times \frac{1}{2}''$ Double Angle Strip in the rear of the model, and a short length of Spring Cord 11 is tied to the centre hole of the Strip 9 and to some fixed portion of the model. The tension of the Spring Cord should be adjusted so that it always holds the $2\frac{1}{2}''$ Strip firmly against the edges of the spool 1.

The following is a list of parts required to build the Meccano coil-winder :—

2 of No. 2	1 of No. 22A	2" of No. 58	1 of No. 95
3 „ „ 5	22 „ „ 37	10 „ „ 59	1 „ „ 96
2 „ „ 8A	2 „ „ 37A	1 „ „ 62	4 „ „ 108
2 „ „ 11	1 „ „ 48A	1 „ „ 80A	1 „ „ 115
1 „ „ 15A	2 „ „ 52	14" „ „ 94	2 „ „ 133
1 „ „ 16			

All the models described in this article will work excellently if constructed carefully, but it must be borne in mind that the slightest fault in a piece of electrical apparatus may not only prevent the model working correctly, but it may also cause considerable damage.

Grand Model-Building Competition



THERE IS STILL TIME TO ENTER!

IN last month's "*M.M.*" we announced the special "Christmas" Competition—one of the most important competitions that have yet been organised in the pages of the "*M.M.*" The last day on which entries from competitors residing in the British Isles can be received is January 31st, and the last day for overseas entries is 30th April next, so there is still ample time for readers to send their work if they have not already done so. We are confident that this competition will break all previous records, both as regards the quantity and quality of the entries. If suitable, many of the prize-winning models will be featured in the "*M.M.*" and in subsequent issues of the Instruction Manuals. Sixty valuable prizes and a number of Meccano Certificates of Merit will be distributed.

The Competition is open to boys and girls of all ages from all over the world. The entries will be divided into four separate sections, as detailed below, and the age of every competitor will be taken into consideration when awarding the prizes. No restrictions are laid down as to the number or variety of the parts that may be used.

Boys frequently write to us asking for particulars of the "most complicated models that can be built with a Number so-and-so Outfit," but, as all staunch Meccano boys are aware, the most complicated structures do not necessarily win the chief prizes. The simplest model may carry off the top prize if it is built on new and original lines.

What You Have To Do

When you have decided upon the subject for your model, you should copy it faithfully and neatly in standard Meccano parts and then send in photographs or clear drawings of your model, together with any descriptive matter that you consider necessary. Remember, the two key words to success are "originality" and "neatness."

The best plan is to send a photograph of your model, of course, but if you cannot manage to obtain a good photograph a clear drawing will do as well. Neither photographs or drawings need be your own work, but the model itself must be the result of your own unaided efforts.

You should send in all necessary explanations concerning your model. These should be written carefully and neatly on one side of the paper only, and they should be as concise as possible. A boy once sent in so many sheets of paper that our Office Boy had a severe shock, for he thought that the proofs of next month's "*M.M.*" had arrived a fortnight before they were due!

Just a word as to the model itself. Try to be as original as possible in the choice of your subject. Models that really work, or that may be put to some practical use, naturally attract the attention of the judges more than models that refuse to work or fail to reproduce the movements of their prototypes. Any number of parts may be used in the model, but it should be borne in mind that a simple model of straightforward design stands a better chance of coming out at the top of the list than a badly constructed, scrappy-looking model however complicated its mechanism may be. Good, sturdy construction will weigh heavily in the favour of any model.

There are no entry forms to fill in and no fees to pay. The only condition laid down is that the model must be your own unaided work as regards both design and construction. Actual reproductions of existing Meccano models cannot be accepted as entries in the competition.

More than one model may be entered in the competition, but all entries from any single competitor must be sent under the same cover. No single competitor can win more than one prize; if he sends two or three models they will be considered jointly when awarding the prizes.

We repeat that, if suitable, many prize-winning models will be included in forthcoming Instruction Manuals and other Meccano publications that we have in mind, so that your competition model may be rebuilt again and again by Meccano boys of all nationalities. This in itself will be regarded by most Meccano boys as a sufficient reward for the labour involved.

LIST OF PRIZES

The Prizes to be awarded in Section A, B, and D are as follows:

First Prize: Cheque for three guineas.

Second Prize: Cheque for two guineas.

Third Prize: Cheque for one guinea.

Twelve Prizes, each consisting of Meccano products to value 5/–.

A limited number of Certificates of Merit and complimentary copies of "Meccano Standard Mechanisms" Manual.

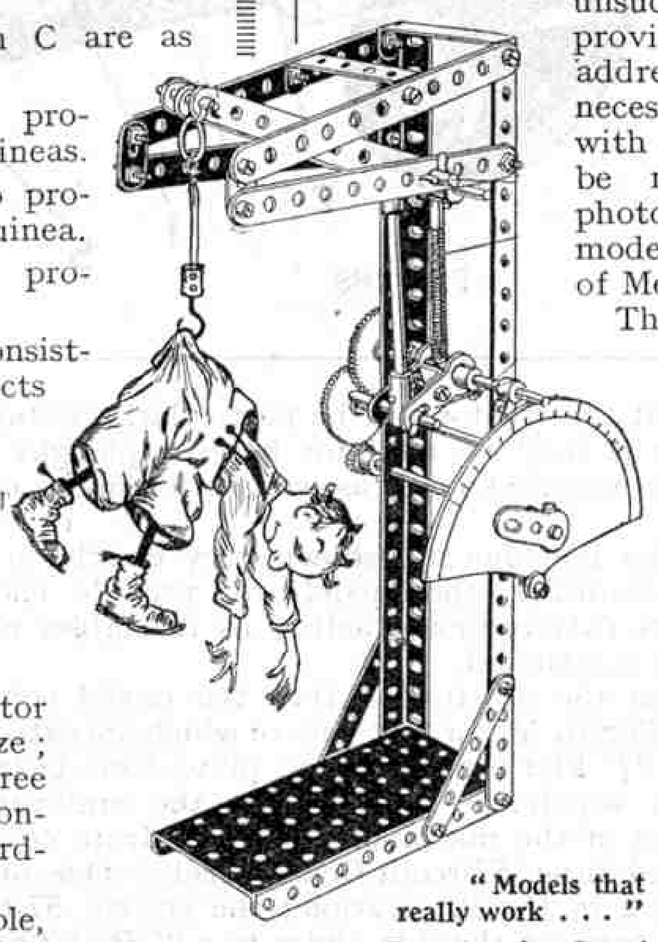
The Prizes in Section C are as follows:—

First Prize, Meccano products to value two guineas.

Second Prize, Meccano products to value one guinea.

Third prize, Meccano products to value 10/6.

Twelve Prizes, each consisting of Meccano products to value 5/–.



"Models that really work . . ."

The competition will be divided into four different Sections, as follows:—Section A for competitors residing in the British Isles and over 15 years of age. Section B, for competitors residing in the British Isles and between the ages of 12 and 15 years. Section C, for Competitors residing in the British Isles and under 12 years of age. Section D, for Competitors of all ages residing overseas.

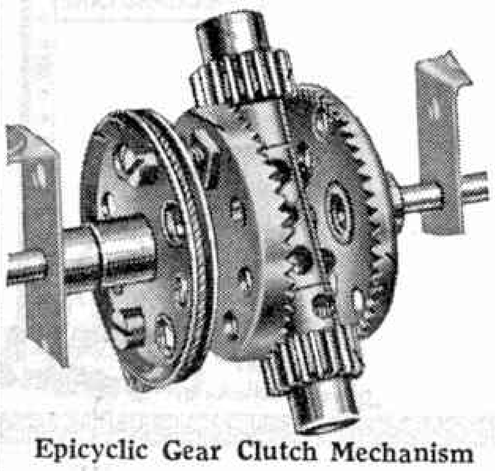
Important Instructions

Do not send the actual model. Your photographs or drawings, if unsuccessful, will be returned providing that a stamped addressed envelope of the necessary size is enclosed with your entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Ltd.

The following instructions must be followed closely:—

Your name and address must appear on the back of each photograph or sheet of paper used, together with your age, name of the competition ("Christmas" Model-building Competition) and the Section in which the model is entered. Address the envelope "Christmas Competition," Meccano Ltd., Binns Road, Liverpool.

Entries for Sections A, B, and C must be received by 31st January, 1928. Closing date for Section D: 30th April, 1928.



Epicyclic Gear Clutch Mechanism

Suggestions Section

Edited by "Spanner"

(108)—Meccano Walking Tractor

(A. F. Spilhaus, Rondebosch, South Africa, and C. Lee, Claygate, Surrey)

THE Meccano Walking Tractor shown in the accompanying illustration is a model of an ingenious device invented recently by Mr. Nilsson, a Stockholm engineer. This curious machine is designed to travel over very rough surfaces where ordinary wheeled vehicles could not pass. The problem of travelling over uneven ground has occupied the attention of inventors for some time, of course, and the caterpillar action, perfected during the War in connection with army tanks, was one of the most important advances in this direction.

The walking tractor, it is claimed, is more simple and efficient than the ordinary "caterpillar" tractor, however. It will haul or carry a load without the use of either driving wheels or "caterpillars," and its novel method of propulsion gives a positive non-slip grip on even the worst surfaces.

The invention was described briefly in the "*M.M.*" for January 1925, but for the benefit of those readers who are unable to refer to that number, we may repeat that the tractor uses levers or "legs" to push or pull itself along. The legs are driven by a motor mounted on the frame of the tractor midway between the legs and a pair of wheels, which run freely. Power is transmitted through gearing to produce a movement of the legs, and this movement is almost identical to that of the legs of a horse, when the animal is hauling a load. The addition of a heavier load on the tractor causes the legs to take an increased grip on the ground. It is only necessary, therefore, to provide the tractor with suitable shoes, which vary according to the nature of the ground on which the vehicle is working. The legs are directly geared members without cams, springs, or chains.

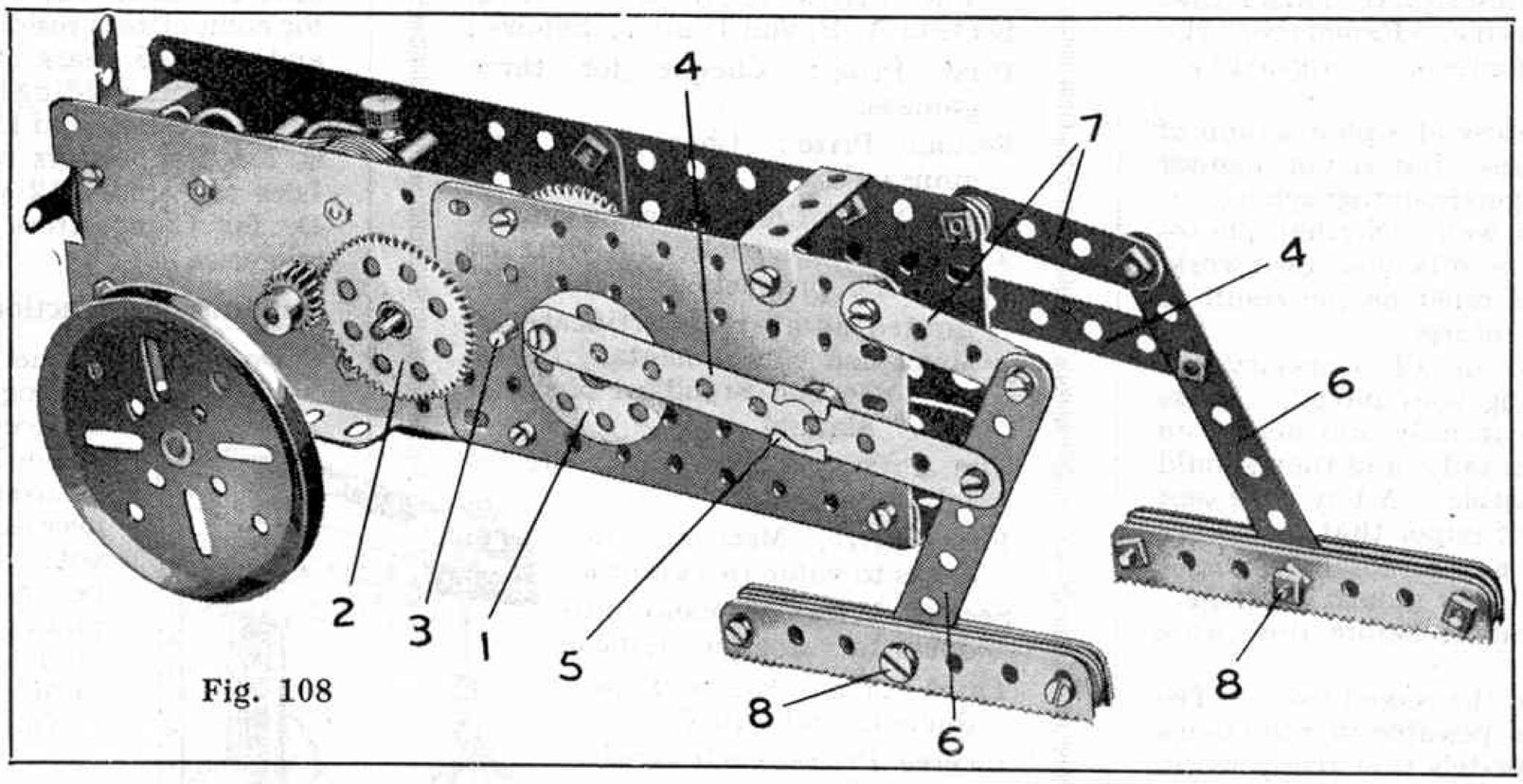


Fig. 108

It is anticipated that the tractor will be particularly useful for agricultural work, for it may be used for hauling ploughs and harrows, etc., over the roughest land, as well as for many other farm purposes.

The principles of the machine are shown very clearly in the Meccano model. Incidentally, the model will provide endless entertainment, and its extraordinary action as it ambles along will cause considerable merriment.

It will be seen from the illustration that the model consists essentially of a 4-volt Electric Motor, the sides of which are extended by means of two $4\frac{1}{2}'' \times 2\frac{1}{2}''$ Flat Plates. These plates form bearings for the gear train by which the motion from the armature is transmitted to the legs of the machine. The gear train consists of three $\frac{1}{2}''$ Pinions and three 57-teeth Gear Wheels. One of the latter can be seen at 2 in the illustration; the second 57-teeth Gear Wheel is secured between the side plates to a 2" Rod 3 and is rotated by means of a $\frac{1}{2}''$ Pinion secured to the shaft of the wheel 2. The third Gear Wheel is fixed to the 2" Rod carrying the Bush Wheel 1. Another Bush Wheel is secured to the opposite end of the latter rod, and these two Bush Wheels are caused to actuate the legs of the model by means of connecting $4\frac{1}{2}''$ Strips 4.

Constructing the Legs and Shoes

These Strips 4 slide to and fro in Eye Pieces 5, which are secured to the shanks of $\frac{3}{8}''$ Bolts that are free to turn in the side plates of the model. The Strips are pivoted to the $3\frac{1}{2}''$ Strips 6 forming the legs by means of a bolt and two nuts (see Meccano Standard Mechanisms Manual, detail No. 262), and their other ends are pivoted by the same method to the Bush Wheels 1. The legs are pivoted at their upper ends, also by the same means, to two 2" Strips 7, and the latter, in turn, are pivoted to the side plates of the tractor.

Each of the Shoes consists of two Rack Strips and six $3\frac{1}{2}''$ Strips. The latter are placed between the Rack Strips in order to increase the weight of the shoes, so that they grip the ground more positively. The Strips 6 are inserted in the centres of the shoes and Pivot Bolts 8 are passed through their end holes. Washers should be placed on the $\frac{1}{2}''$ Bolts securing the ends of the shoes together, so that the shoes are quite free to move about the Pivot Bolts 8.

The Motor is mounted on two 3" Pulley Wheels, the axle of which is journalled through two Angle Brackets bolted beneath the flanges of the Motor. These wheels perform no actual work in the propulsion of the tractor.

The Bush Wheels 1 should be arranged so that the pivots of the connecting Strips 4 are placed at 180 degrees to each other. This causes the legs to work alternately; that is to say, when one shoe is on the ground the other is in mid-air.

Parts required:—

14	of No. 3	2	of No. 16A	12	of No. 37	4	of No. 110
2	" " 2A	1	" " 17	2	" " 38	4	" " 111A
2	" " 6	2	" " 19B	1	" " 48	12	" " 111C
1	" " 6A	2	" " 24	2	" " 50A	2	" " 147B
2	" " 12	3	" " 26	2	" " 53A	1	4-volt Electric Motor
1	" " 16	3	" " 27A	1	" " 59		

CONTRIBUTIONS INVITED

It is worth while to bear in mind that the ideas printed in the "Suggestions Section" may help Meccano enthusiasts. Often we receive letters from readers who describe how they have solved some knotty problem or evolved an interesting model after studying some of the ideas that have appeared in this Section. We shall always be pleased to receive further contributions for the "Suggestions Section." Cash payments are made for Suggestions published showing special merit. Contributions should be addressed to "Spanner," c/o The "*Meccano Magazine*."

"Wanted—An Idea" Competition Results

It will be remembered that this Competition centred round a letter addressed to the Editor of the "Sunday Times" and published in that paper a short time ago. For the benefit of those readers who are unable to refer to the competition announcement, which appeared in the June, 1927, "Suggestions Section," we reprint an extract from the letter:—

> "I read myself to sleep, and usually fall off with the electric light on. I have tried holding the book over the edge of the bed, so that when it falls from my unconscious fingers the resulting thump on the floor shall wake me. Unfortunately, I have got used to the thump, and no longer wake. Have any of your readers successfully surmounted this problem that nightly confronts me?"

We invited "*M.M.*" readers to send along any suggestions on the subject that they might have to offer.

While most of the competition entries were very ingenious, some others were more amusing than useful. Two or three entries consisted merely of post cards on which the competitor put forward some such solution to the problem as "do not read in bed!" Another competitor suggested tying one end of a piece of string to the book, and the other end to the reader's ear!

What the "Sunday Times" correspondent really required was an apparatus which would switch off the light with as little noise as possible immediately he released his hold of the book or paper that he was reading. To be of real use the apparatus should be capable of adapting itself to any bedroom. This is a point that was overlooked by many of the competitors, for they produced elaborate mechanical devices that could only work when the electric light switch was placed quite close to the bed.

After carefully examining every entry the competition judges came to the conclusion that no single competitor had succeeded in producing the exact kind of apparatus required. Therefore they selected two or three of the best entries and combined the most interesting points of each, and in this way they produced the apparatus shown in Fig. A.

The construction of the device is as follows. Two 1" Pulley Wheels are journalled in Single Bent Strips 1, which are attached to the wall by means of 1" × 1" Angle Brackets. One Pulley Wheel should be placed vertically over the switch while the other may be fixed at any convenient distance from it. A catch is constructed from a 12½" Strip, to one end of which is attached a Strip Coupling 2 fitted with a Centre Fork 3. This Strip is pivoted on a ½" Bolt secured to a Double Bent Strip 4, which is screwed to the wall.

A piece of cord tied to the switch knob passes over the pulleys and a heavy weight is fastened to its free end. Before fastening the cord to the switch a Collar should be secured tightly in the position shown by means of a bolt inserted in place of the grub-screw. The Double Bent Strip 4 and the 12½" Strip should be arranged so that when the switch knob is down (with the light "on") the Centre Fork may be placed against the Collar to prevent the heavy weight from coming into action and pulling the switch over to the "off" position.

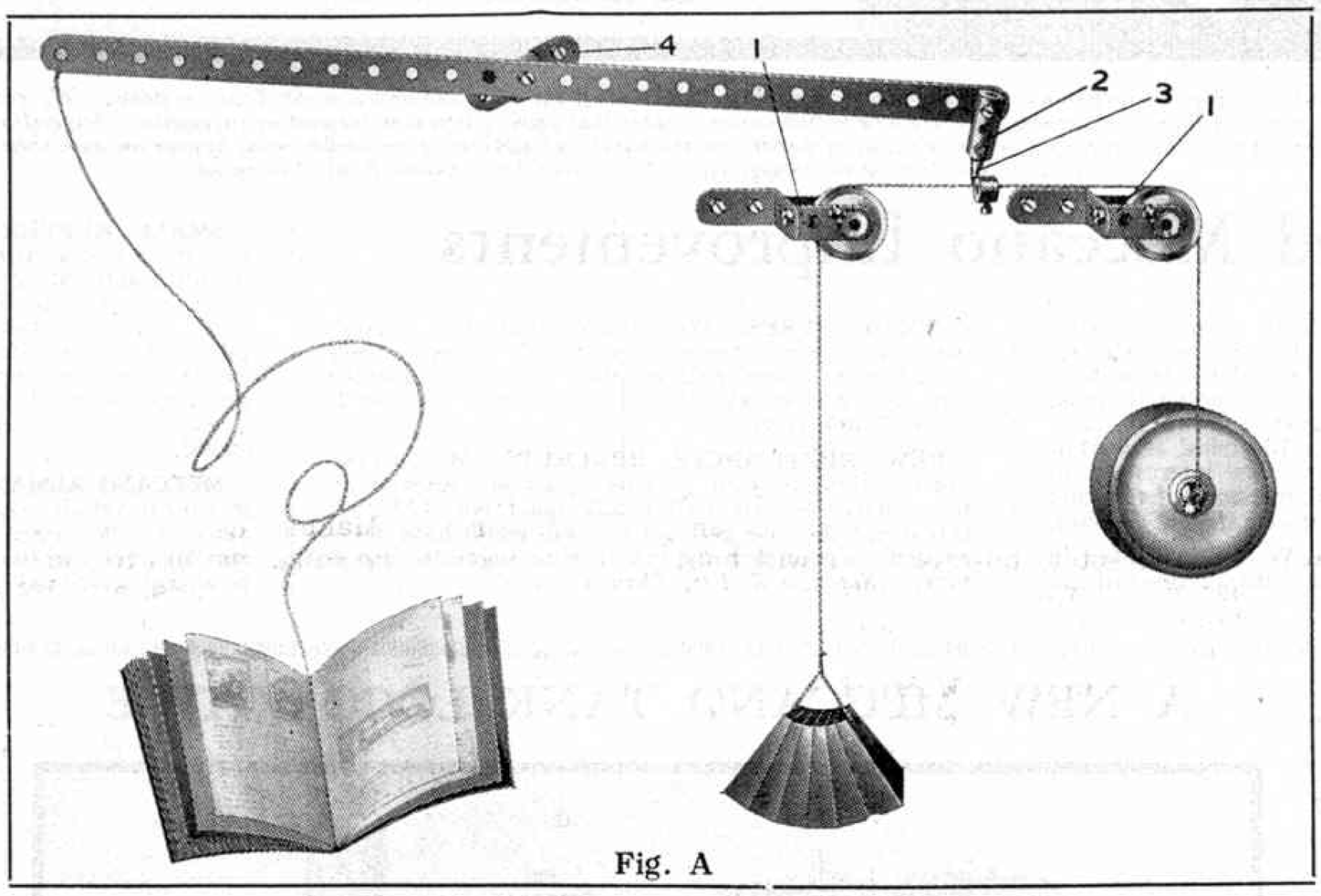


Fig. A

The book or paper is attached by a string to the free end of the 12½" Strip and if for any reason its weight is allowed to act on the Strip, the Centre Fork will promptly be disengaged from the Collar 2, thus allowing the heavy weight to pull up the switch knob and turn out the light. Hence, all the reader has to do when he has finished reading is to drop the book. This may be done consciously or unconsciously, of course. It may be mentioned

(*Continued on page 72*)

(109)—Meccano Manual Stand

(*John Scrivener, Reading, and Another*)

Most Meccano boys will agree that it is somewhat annoying to lose one's page in the Instruction Manual just when one is in the act of completing some intricate portion of a model. In this connection the Meccano Manual Stand shown in Fig. 109 should prove a boon to many readers, for it is designed to maintain the Manual of Instructions always in an easily observable position.

Interesting features of the model lie in the adaptability of the Manual stand to almost any angle and in the fact that the stand swivels about a pivot in the base. In addition, catches are provided to hold the pages of the Manual open in the desired position.

The stand is built up from an 18½" Angle Girder 1 and two 12½" Strips 2 overlapped thirteen holes and secured to the Girder by three 5½" Strips. The centre one of these 5½" Strips is attached to a 2½" × ½" Double Angle Strip 3, secured between the tops of two further 4½" Strips that are bolted to the 3" Pulley 4. This Pulley 4 rests on a second 3" Pulley that is bolted to the base.

A 2" Rod nipped in the boss of the Pulley Wheel 4 is free to turn in the boss of the lower fixed Pulley, and a Collar secured to its end beneath the latter Pulley serves to hold the swivelling frame to the base. This arrangement permits the Manual rest to swivel smoothly but not too easily; a very easy movement would not be advantageous.

If the Double Angle Strip 3 is attached to the vertical 5½" Strips by means of lock nuts (see Standard Mechanism No. 263) so that it is capable of turning stiffly, the angle of the rest may be adjusted to suit personal requirements. The 2" Strips 5 are lock-nutted to ½" × ½" Angle Brackets bolted to the 18½" Angle Girder 1; these strips serve to hold the pages of the Manual open.

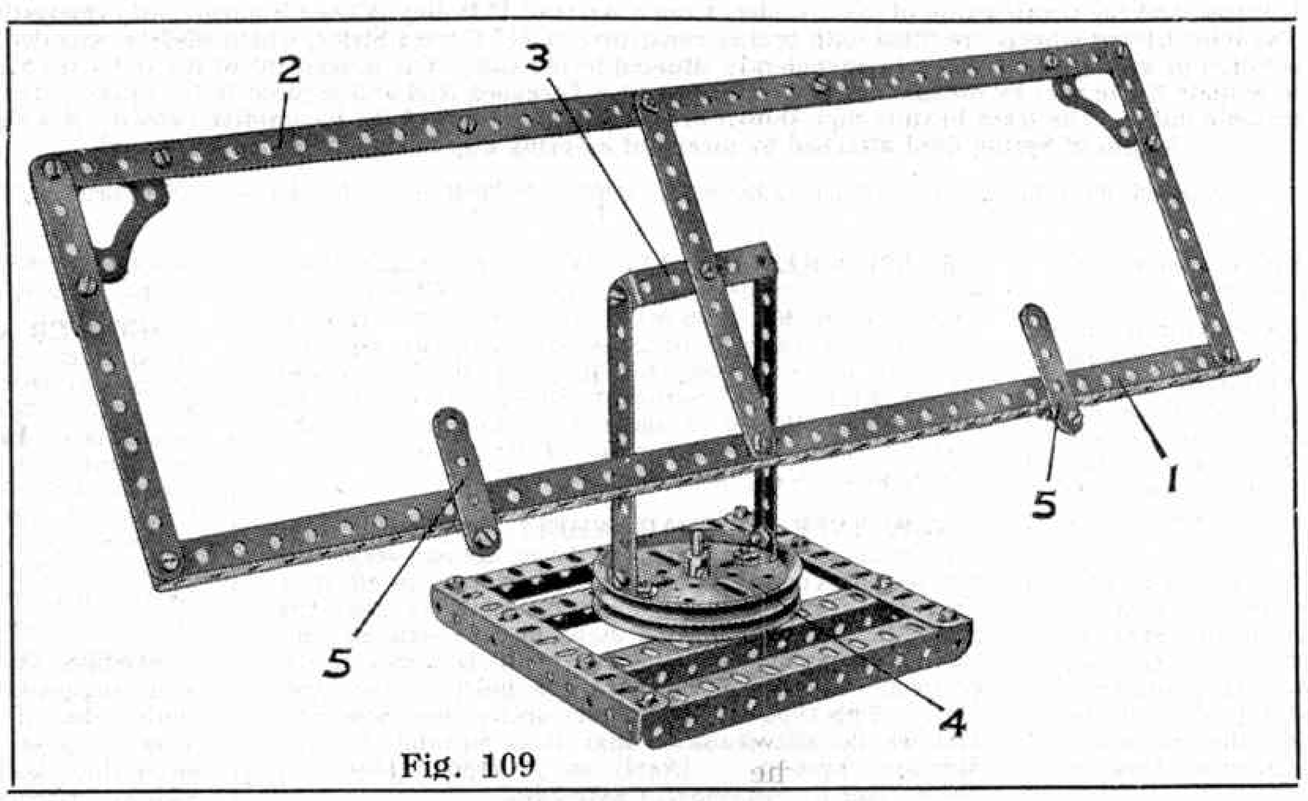


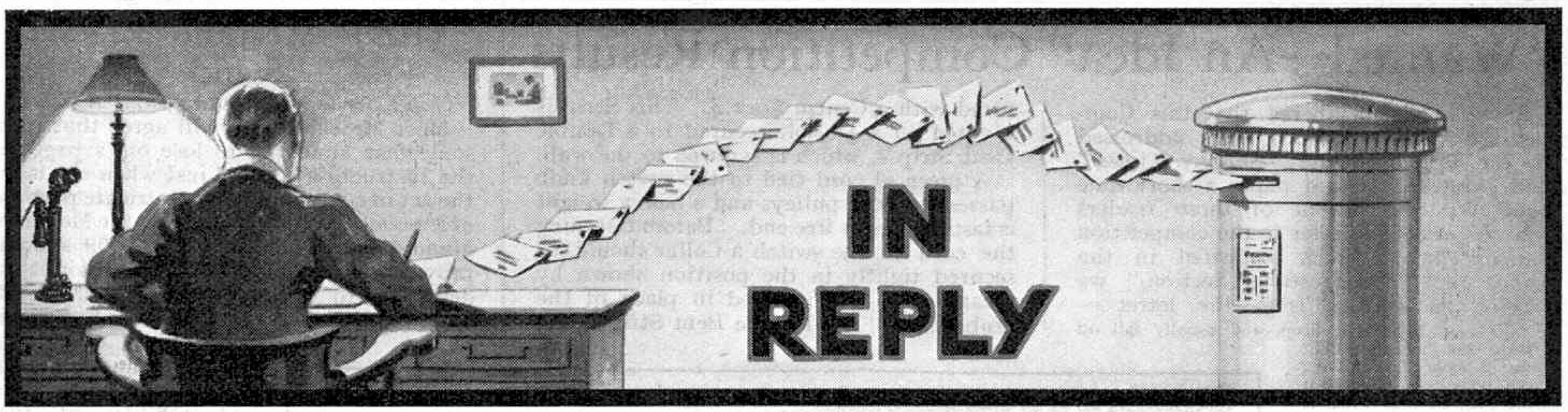
Fig. 109

The following is a list of the parts required to build the model as illustrated:—

2	of No. 1	1	of No. 18a
2	„ „ 2a	2	„ „ 19b
2	„ „ 6	33	„ „ 37
1	„ „ 7a	2	„ „ 37a
6	„ „ 9	1	„ „ 48a
4	„ „ 12	2	„ „ 108

Name Wanted

In connection with the above article describing a Meccano Manual Stand, we shall be glad to hear from the Meccano boy residing in Dorset Street, Hessle Road, Hull, who sent in a similar suggestion, since he omitted to sign his letter.



In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Suggestions submitted for consideration in this section must be written on separate sheets of paper and the name and address of the sender must appear on each sheet used. Envelopes should be addressed to "Suggestions," Meccano Ltd., Binns Road, Liverpool.

Suggested Meccano Improvements

MAGNETISED PLATES.—We do not think that your proposed magnetised Face Plate for use in electric cranes, etc., would prove very popular. Most boys prefer to make such appliances from existing Meccano parts. An efficient electro-magnet is shown attached to a crane in Model No. 5 in the Electrical Manual of Instructions. Such a device is more interesting to construct and use than a special accessory of the kind you suggest. (*Reply to H. Pearson, March, Cambs.*).

INTERNAL-TOOTH GEAR.—We are interested in your suggestion regarding the introduction of an internal-toothed gear wheel of such a size to permit its application to a Face Plate. This is a very interesting suggestion, and no doubt the part would prove invaluable in the construction of epicyclic gearing, etc. We are giving the matter very careful consideration, but we fear that we cannot enter into production with such a part for the present. (*Reply to D. Ashworth, Dursley, Glos.; H. A. Shaw, Sheffield; and others*).

REGULATORS FOR CLOCKWORK MOTORS.—In reply to your suggestion regarding Clockwork Motor regulators, we fear that it is scarcely a practical proposition to include such appliances in our existing Motors. From time to time many ingenious devices have been put forward with a view to governing the speed of the motor; two particularly interesting ideas in this connection were published in the "Suggestions Section" for April 1926 and June 1927 (Suggestions Nos. 29 and 88). (*Reply to I. Haslam, Kirby Lonsdale, Carnforth*).

MOTOR HORN.—A miniature bulb or mechanical horn would be an extremely difficult article to manufacture. Moreover, it would be adaptable only to model motor cars, and we hesitate to introduce a part with so limited an application. (*Reply to F. Athen, Enfield*).

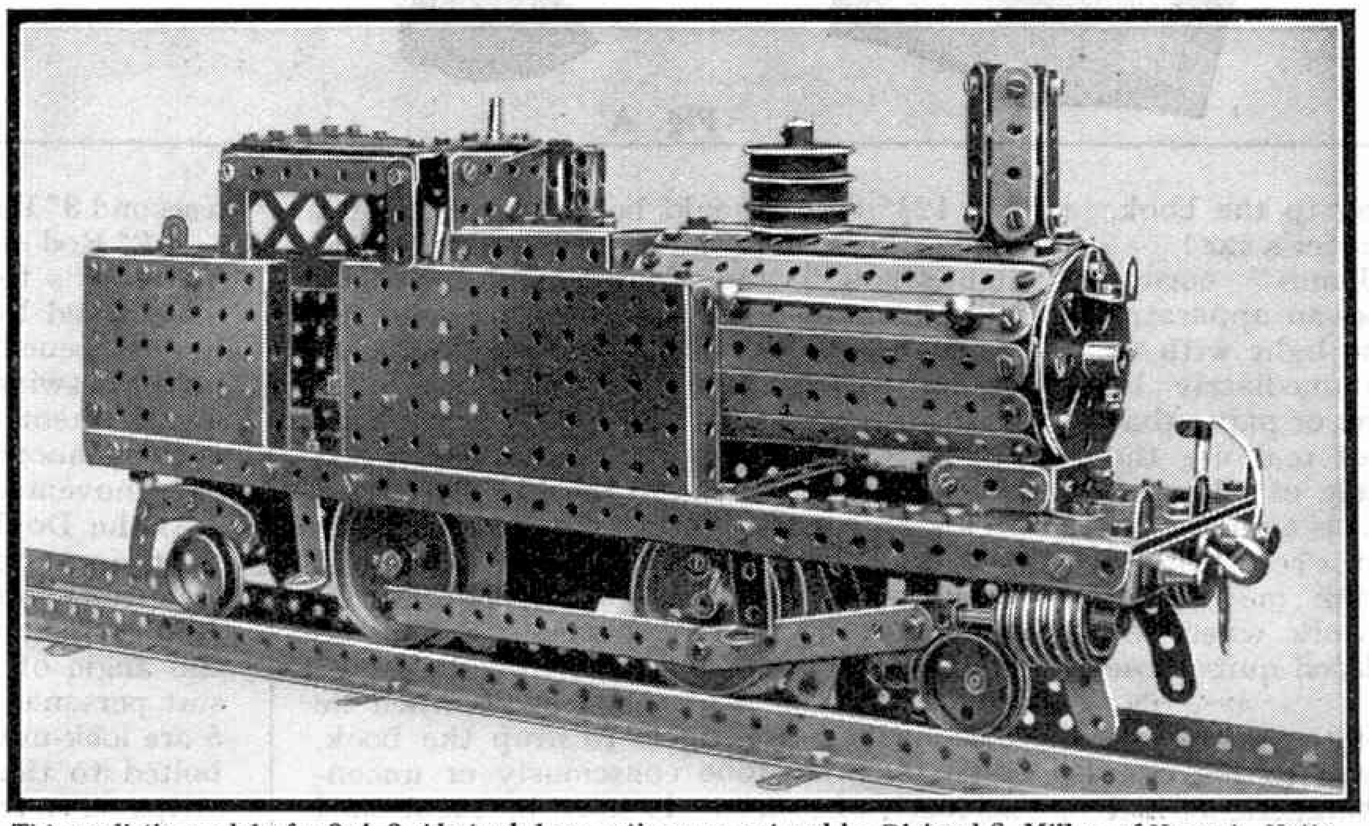
RACK BAR.—We note your suggestion for a serrated bar of rectangular section, having the serrations of the same width and pitch as the standard Pinions or 1" Gear Wheels. Such a part might be of use for meshing with the larger Gear Wheels, but we do not consider that the advantages that it offers over the existing Rack Strip (part No. 110) are sufficient to warrant the expense of manufacture. (*Reply to J. Jones, Ascot Vale, Victoria*).

MECCANO CAM.—We have noted your suggestion regarding the addition of cams to the Meccano system, but we fear that we cannot entertain the idea at present. There are several ways of constructing an efficient cam from standard Meccano parts; interesting examples of Meccano cams and tappets will be found under details Nos. 264/6 in the Standard Mechanisms Manual. (*Reply to L. Barnett, London, S.E.*10).

SOLID TYRES.—We think that the present Meccano Dunlop Tyres fitted to 3" Pulley Wheels would serve quite well in place of your suggested new heavy road wheels with solid tyres. (*Reply to E. N. Gouch, Hove*).

NEW RIGHT-ANGLE BRACKETS.—We believe the functions of your proposed part are covered by the existing Simple Bell Crank (part No. 127). If this is not the case perhaps you will let us have some particulars regarding the use of your suggested accessory. (*Reply to R. Fer, Thames Ditton*).

A NEW MECCANO TANK LOCOMOTIVE



This realistic model of a 2–4–2 side tank locomotive was entered by Richard S. Miller, of Newark, Notts., in a Meccano Model-building Competition two or three years ago. The model comprises several excellent features, and the construction of the cylinders from a series of 1" Pulley Wheels is particularly interesting. The four driving wheels are fitted with brakes consisting of 2½" Curved Strips, which may be operated on rotation of a 1" Sprocket Wheel conveniently situated in the cab. The movement of the latter is caused to actuate the brakes by means of a nut travelling on a Threaded Rod and secured to the brake shoes by suitable links. The train heating pipe shown mounted in the front of the locomotive consists of a short length of Spring Cord attached by means of a Spring Clip to the end of a vertical rod.

6" SPROCKET WHEEL.—We do not think there would be much demand for Sprocket Wheels of so large a diameter as 6 ins. The advantages that it offers may already be obtained by using two separate sprocket drives, each consisting of a 1" Sprocket Wheel driving a 3" Sprocket Wheel. If the second 1" Sprocket Wheel is secured to the shaft of the first 3" Wheel a speed ratio of 6 : 1 would result. (*Reply to F. Marquand, Woodville, N.Z.*).

NEW TYPE OF GEAR WHEEL.—Your diagrams concerning a new type of Gear Wheel are not very clear but we gather that your proposed part is, in effect, a Face Plate having a large number of holes near the perimeter and meshing at right angles with another Face Plate having a number of protruberances on the perimeter corresponding with the holes in the first plate. This type of gear is a very ancient one, however, and we do not consider that it is suitable for the Meccano system. (*Reply to J. Pooley, Hemyock, Devon, and C. Beaumont, Canterbury*).

SMALL RUBBER RINGS.—Your idea of using rubber umbrella rings for tyres on 1" Pulley Wheels is quite interesting and we can recommend it to others who wish to adopt the idea. We may mention here, however, that we are considering the possibility of introducing small rings of the type you mention, as there appears to be a considerable demand for accessories of this kind. (*Reply to F. Auld, London, E.*12; *L. Elliss, London, S.E.*9; *and many others*).

MECCANO ALMANACS.—We were very interested in your novel idea concerning the design of a Meccano almanac. We agree that this would look very well in a Meccano clubroom or elsewhere and that it would be useful as well as ornamental. We shall bear your proposal in mind, although we doubt whether we can do anything in the matter for a year or so. (*Reply to H. Evan, Bristol*).

DOUBLE HELICAL GEARS.—Double helical gears for use in the Meccano system would prove very expensive to produce and we are unable, therefore, to entertain the idea of manufacturing them. The present range of gears is quite satisfactory for all model-building purposes. (*Reply to T. Peare, Plymouth*).

6" FLANGED CIRCULAR PLATE.—We do not think there would be much demand for a 6" Circular Plate with a slotted flange similar to that fitted to the Hub Disc. A Circular Plate bolted to a Hub Disc or Circular Girder should cover most of the functions of your suggested accessory. (*Reply to T. Peare, Plymouth*).

A MECCANO P.I.V. GEAR.—We fear that the introduction of a miniature P.I.V. gear is impracticable. Even if it were possible to produce the gear on so small a scale, the cost of manufacture would be such as to prohibit the sale of the accessory amongst the majority of Meccano boys. We have no doubt that working Meccano models of the gear could be built up from existing parts. (*Reply to J. Brodin, La Fleche, France*).

SHORTER CRANKS.—With regard to your proposal concerning the introduction of shorter Cranks, we believe that the movements you have in mind can be obtained with existing parts. The new Crank with centre boss, for example, gives a ½" throw, and we do not think that the extra arm is likely to get in the way; indeed, it should prove very useful as a balance for the Crank. A throw of ½" can also be obtained, of course, by securing a Coupling at right-angles to the end of a Rod and using it as a crank, with the crank pin secured in the transverse hole in its outer end. (*Reply to A. E. F. Spence, Levenshulme, Manchester*).

BOSSES OF WHEELS.—We were interested in your suggestion re the extension of wheel bosses on both sides of the wheel. We think, however, that your proposal would render wheels and gears, etc., somewhat bulky and awkward to use in confined spaces. (*Reply to A. Dyer, London, E.*11).

Suggested Hornby Train Improvements

HORNBY RACK RAILWAYS.—We do not think that your proposal re a rack rail, consisting of a length of rail laid between the ordinary lines with teeth to engage with suitable gears beneath the engine, would prove a popular addition to the Hornby system. Rack railways are uncommon, and a model of such a type could not be used very well in conjunction with ordinary Hornby railways. Moreover, the proposed accessory would entail re-designing the existing locomotives. (*Reply to J. Thomson, Newcastle-on-Tyne*).

ELECTRIFICATION OF MORE HORNBY ENGINES.—We hope to fit electric motors to our No. 1 Engines and other accessories, but of course the new electric locomotives cannot be introduced for some time. In reply to your other suggestion, we hope also to introduce Southern Railway colours to the Hornby system at a later date. (*Reply to E. H. Smith, Redhill*).

No. 2 TANK PULLMAN SET.—It is quite a simple matter to build up this set by purchasing the component parts separately, and we do not think it would be worth our while, therefore, to adopt your suggestion. (*Reply to John Hater, Newbury*).

REGULATOR FOR LOCOMOTIVES.—We have received numerous suggestions regarding the addition of a speed regulator in Hornby Locomotives, but the inclusion of such an appliance in the present models would greatly increase the cost of manufacture, as it would entail the entire reconstruction of the whole of the engine mechanism. (*Reply to R. Smith, Hythe*).

DOUBLE ROAD TUNNEL.—This is an interesting suggestion. We will consider the production of a two-way Tunnel similar to the one that you propose. (*Reply to R. Smith, Hythe*).

PLANS OF LAYOUTS.—We note your suggestion that it would be useful to publish blueprints of model-railway layouts. We think, however, that the majority of Hornby enthusiasts prefer to plan their own railways and we doubt whether the demand for such costly productions would justify our adoption of your idea. However, your suggestion is covered already to a certain extent by a new booklet that we have just published entitled "How to get More Fun out of Hornby Trains" (see the announcement on another page of this issue). This comprises a number of very useful diagrams of various layouts. The booklet may be obtained from Meccano dealers or direct from us price 3d., or 4d. post free. (*Reply to S. Burcher, Remuera, Auckland, N.Z.*).

4–6–0 AND 4–4–2 SCALE MODEL LOCOMOTIVES.—In reply to your suggestions regarding certain new Hornby locomotives, we fear that we are unable for the present to copy any particular type of 4–4–2 or 4–6–0 engine. (*Reply to G. M. Fidler, Yarm, Yorks.*).

INCLINED RAIL.—We doubt whether the manufacture of an accessory of this type would be worth our while in view of the fact that it is a very simple matter to bolster-up the track when it is desired to incorporate an incline in any model railway layout. (*Reply to H. Hauptmann, Sydney, N.S.W.*).

ATTACHMENT FOR BUFFER STOPS.—We are somewhat puzzled by your suggestion regarding an attachment for Buffer Stops, by means of which wagons, etc., may be secured to the Buffer Stops when on an incline. As far as we know this practice is not adopted on actual railways, and we do not consider it is advisable, therefore, to introduce it to the Hornby system. No doubt the necessity of such an appliance could be obviated fairly simply. For example, you could prevent your trucks running away by putting some small obstacle on the line; this, we know, is done sometimes in actual practice. (*Reply to N. E. Woods, London*).

VESTIBULES FOR CORRIDOR COACHES.—You will be pleased to learn that these accessories will be fitted to all Hornby Pullman cars. (*Reply to B. Herbert, Sunderland*).

REDUCTION IN SIZES OF COUPLINGS.—We are aware that the Hornby Train couplings are a little large, but it is impossible to reduce their size owing to the sharp curves that sometimes have to be negotiated in Gauge 0 layouts. (*Reply to P. R. Brown, Leeds*).

BOGIE GUARD'S VAN.—We note your proposal regarding the introduction of a guard's van on two four-wheeled bogies, for use in connection with the Hornby Pullman Train. We may say that we are at present carrying out experiments with a view to introducing an accessory of this kind, and we hope to make an announcement on the subject in the near future. (*Reply to J. C. Jenkins, Terowie, S. Australia, and A. W. Langley, Ashford*).

ALTERATIONS TO HORNBY No. 1 ENGINES.—We are interested in your suggestion that we should apply No. 2 Hornby Clockwork mechanisms to our No. 1 Locomotives, thus eliminating the use of outside cylinders. We fear, however, that the resulting proportions would be far from correct and that the majority of Hornby enthusiasts would prefer the existing type of locomotive to the re-built ones. (*Reply to C. Dawe, London, S.E.17*).

HORNBY ANNUAL.—We consider that your requirements have already been fulfilled by the Hornby Book of Trains, which both advertises our trains, as you suggest, and also deals with the history and operation of railways. (*Reply to E. Vivian, Parkstone*).

NEW HORNBY TRAINS.—We have had in mind your suggestions regarding the addition to the Hornby system of models of various famous trains, such as the "Flying Scotsman," "Caerphilly Castle," etc., and in this connection we would draw your attention to the announcements that have appeared recently, (*Reply to A. N. Warden, London, and M. English, Blackheath*).

SWISS MOUNTAIN RAILWAY.—No doubt a train set on these lines would prove very picturesque, but we doubt whether there would be much demand for it, owing to the inconvenience of constructing an appropriate track. (*Reply to A. N. Worden, London*).

ELECTRICAL CONTROL POINTS.—We are looking into the question of adopting electrical points for operation by means of the Hornby Control system. Of course, the demand for electrical points fitted in this way is not so great as the demand for ordinary Control Points, because in an electrical layout many of the functions of the Control System—such as the stopping and starting of the trains—may be carried out simply by switching the current on and off. (*Reply to B. Herbert, Sunderland, and C. Jackson, Cardiff*).

COLOURED DOMES AND BLACK SMOKE-BOXES.—Your suggestions have been noted. We hope to make a further announcement in the near future concerning the colouring of domes and smoke-boxes according to actual railway practice. (*Reply to G. M. Fidler, Yarm, Yorks., and Philip Lyth, Newcastle, Staffs.*).

OVAL BUFFERS FOR ROLLING STOCK.—The oval-headed buffers you suggest would hardly have the effect of preventing interlocking between gauge 0 wagons unless they were abnormally wide, or the curves exceptionally easy. (*Reply to S. J. Buckley, Luton; B. Graves, Taunton; and J. G. McKean, Turramurra, Australia*).

DETAIL ON HORNBY TRAINS.—We thank you for your suggestion to the effect that Hornby Trains should have more detail on them, but we would point out that, although this point is continually receiving more and more attention, Hornby Trains are designed rather for long life and hard work than as scale models of any particular type of engine. (*Reply to G. S. Thomas, Maestey, Wales*).

HEAVY WHEELS ON ROLLING STOCK.—The addition of heavy cast wheels with spokes to Hornby Wagons and Tenders, etc., would greatly increase the cost of manufacture, and consequently the prices of the improved accessories would be greatly in excess of those ruling at present. (*Reply to G. M. Fidler, Yarm, Yorks.*).

4–6–4 TANK LOCOMOTIVE.—The limited possibilities of an engine of this type on a small railway containing sharp curves, together with the necessary high cost of manufacture, renders this an undesirable type of locomotive to introduce at present. (*Reply to J. G. McKean, Turramurra, Australia*).

SOUTHERN BELLE.—As stated in these pages previously, we are considering the production of a Southern railway set, and hope to make an announcement in that respect at some future date. (*Reply to J. Bompas-Smith, Manchester, and others*).

SIX-COUPLED CLOCKWORK LOCO.—We are looking into the possibilities of adopting the six-coupled type of motor as an addition to our present system. (*Reply to Martin Agar, Bristol*).

COUPLED WHEELS FOR No. 1 TANK ENGINES.—Further to our previous statements in this respect we have been experimenting with a coupled No. 1 Tank Engine, and hope to make a further announcement in the "*M.M.*" in the near future. (*Reply to J. Blockwell, Sheffield*).

OUTSIDE CYLINDERS.—We fear that the reconstruction of our present 4–4–0 Loco to the extent of adding outside cylinders would cause an additional expense which would greatly outweigh the benefits to be gained. We would refer those Hornby enthusiasts who have a particular desire to possess an outside cylinder loco to our Hornby 3C or 3E series. (*Reply to A. Hayes, Liverpool, and others*).

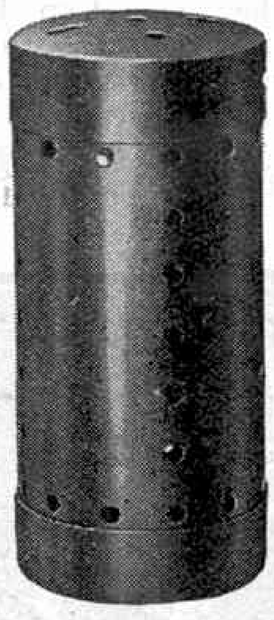
HORNBY RAILWAY CLUBS.—We continue to receive many interesting suggestions and ideas concerning the formation of Hornby Model Railway Clubs on the lines of the Meccano Clubs, for the benefit of those who are particularly interested in this branch of engineering. We are giving the subject very careful attention. (*Reply to N. E. Woods, London*).

ROTARY TIPPING WAGONS.—With regard to your statement that these wagons are liable to overturn when unloading, we fear it would be difficult to prevent this occuring on any model by simply replacing the wheels for heavier ones. We find that, with ordinary care, normal loads may be discharged from these wagons without making any alterations to their design. (*Reply to B. Herbert, Sunderland*).

BRAKES ON LOCOMOTIVES.—We note your suggestion that brakes should be put in the rear of clockwork mechanisms, because the engine is liable to jerk itself off the track when it encounters the special lever on the rail. We think, however, that if the working parts of the present braking appliance are oiled well, no accident will happen. (*Reply to R. Parnell, London, S.W.16*).

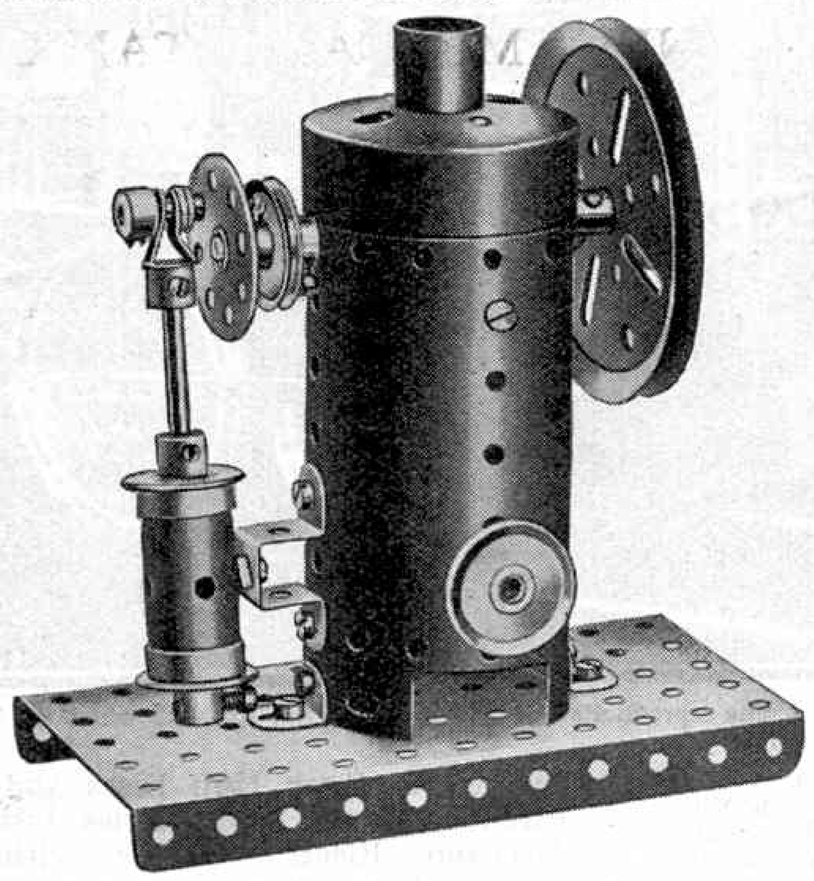
CODE LAMPS.—Your suggestion that Hornby Lamps should be slotted and brackets fitted to the locomotives to facilitate correct train indication is interesting, and we are looking into the possibilities of applying such an idea to the system. (*Reply to L. Wentworth S James, Glasgow*).

AN IMPORTANT MECCANO ADDITION



We illustrate the new Meccano Boiler, part No. 162, which is now available. It is perforated with the standard equidistant holes and can be incorporated in Meccano locomotives, stationary engines, and numerous other models of a similar type. It is fitted at each end with a movable cap or "boiler end." Price, complete, 1/–. The Boiler end may also be obtained separately, part No. 162a, price 3d. each.

There is no doubt that the Meccano Boiler constitutes one of the most important innovations that have been made to the Meccano system within the last few years.



Some idea of the adaptability of the new Boiler will be gathered from the accompanying illustration of a Meccano Vertical Steam Engine with oscillating cylinder. This model makes use of several other new parts that have been introduced quite recently, namely, the Sleeve Piece, ¾" Flanged Wheels, End Bearing, and Chimney Adaptor.

In constructing the model steam engine the cylinder should be pivoted to the Double Bent Strip (shown bolted to the Boiler) by means of a bolt and two nuts, as in Standard Mechanism No. 262.

Results of
Meccano Model-Building Contests

By Frank Hornby

"September" Competition, "Home" Section

THE Meccano Model-building Contest announced in the September, 1927, issue of the "*M.M.*" brought a great response from all quarters. The entries received were of a particularly high standard, their most noticeable features being originality of design and the soundness of their construction—both of which points, as we have repeatedly reminded competitors, count far more than anything else in the opinion of the judges. The names of the prize-winners in the "Home" Section are given below. The results in the Overseas Section are not yet known, of course.

Section A (Competitors residing in the British Isles).

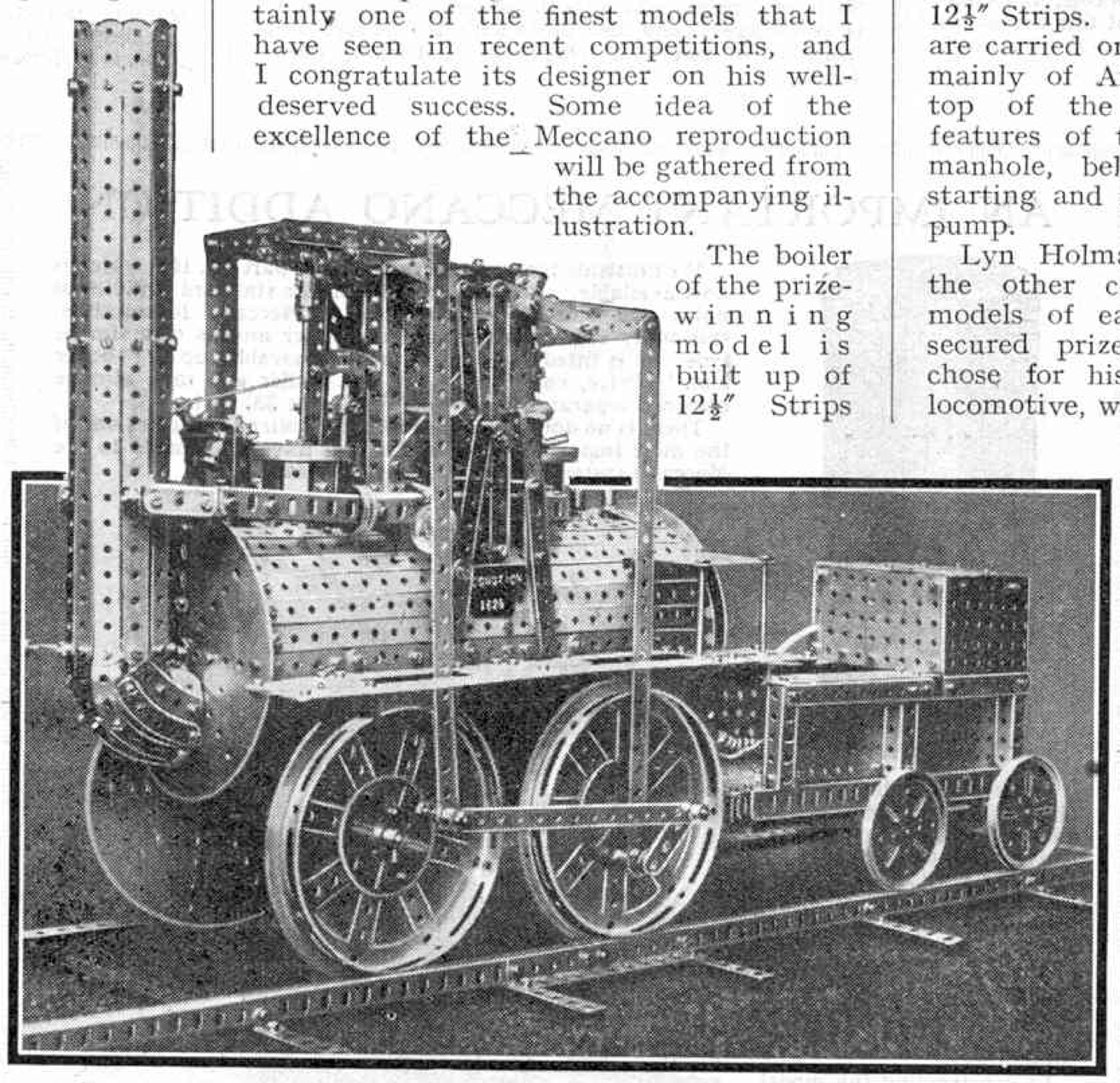
FIRST PRIZE (cheque to value £3-3s.): R. S. Miller, Newark, Notts. SECOND PRIZE (cheque to value £2-2s.): E. J. Wright, London, W.C.1. THIRD PRIZE (cheque to value £1-1s.): C. K. Kernahan, Belfast.

SIX PRIZES, each of Meccano products to value 10/6: E. W. White, London, N.1; A. Holmes, Gorton, Manchester; Miss P. Aspinall, Bampton, Devon; M. C. Bowron, Stoke Bishop, Bristol; Lyn Holman, Camborne, Cornwall; S. C. Mitchell, Wavertree, Liverpool.

TWELVE PRIZES, each of Meccano products to value 5/-: L. Hollyoak, Coventry; W. A. B. Barham, London, S.E.24; R. Mason, Leeds; P. Neal, Harrow; F. A. N. Hitch, Gosport; R. Lowne, Norwich; K. G. Budden, Southsea; V. Thompson, Woodhall Spa; H. A. Davies, Abergele, Denbighshire; John Redfern, Lower Broughton, Manchester; L. Hope, Weston-super-Mare; T. W. Ellision, Sutton Coldfield.

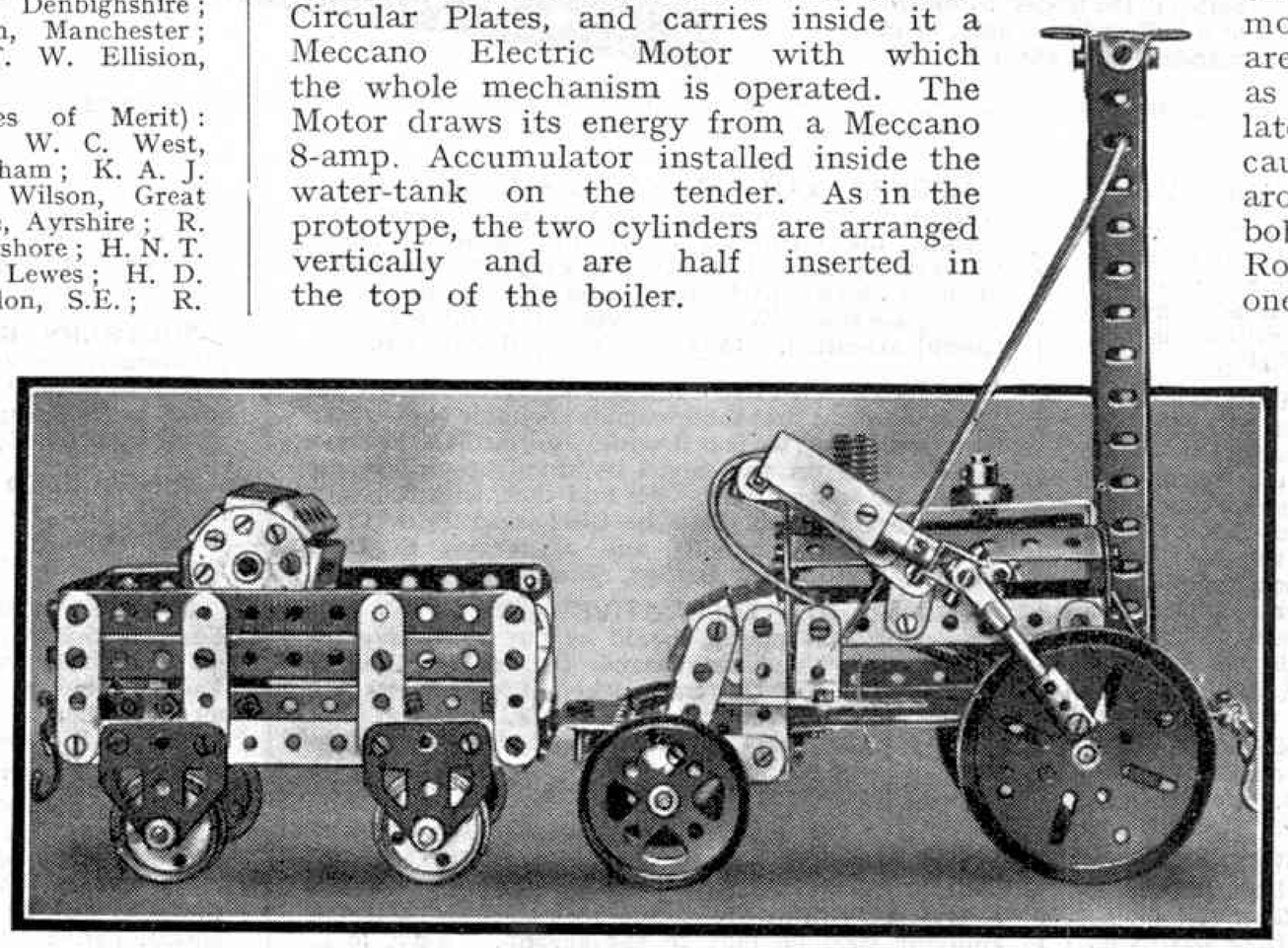
SPECIALLY COMMENDED (Certificates of Merit): H. M. Herbert, March, Cambs.; W. C. West, London, S.W.4; P. A. Wood, Oldham; K. A. J. Webber, London, S.W.15; C. Wilson, Great Yarmouth; H. B. Jones, Maybole, Ayrshire; R. Lamont, Greenock; R. Dolphin, Pershore; H. N. T. Hall, Beckenham; C. B. Hodges, Lewes; H. D. Hosegood, South Norwood, London, S.E.; R. Cairns, Edinburgh; E. Bishop, Hailsham; G. Pamplin, Nottingham; F. Crawley, London, S.W.11; N. W. Peace, Peterborough; L. Kitchin, Barrow-in-Furness; G. Manktelow, Brighton; E. T. Agius, Hampstead, N.W.3; S. Eaton, Leicester; J. Rozelaar, Wrekin College, Shropshire; R. S. Penoyre, Banbury, Oxon; S. C. Herbert, London, S.E.15.

It is an interesting coincidence that three of the prize-winning entries should take the form of models of famous early locomotives. R. S. Miller secured the First Prize with a very fine 1 : 9 scale model of Stephenson's "*Locomotion*" No. 1," which, as most "*M.M.*" readers will be aware, was the first locomotive to be used for passenger traffic. This is certainly one of the finest models that I have seen in recent competitions, and I congratulate its designer on his well-deserved success. Some idea of the excellence of the Meccano reproduction will be gathered from the accompanying illustration.



A fine reproduction of "Locomotion No. 1," with which R. S. Miller secured First Prize

The boiler of the prize-winning model is built up of 12½" Strips secured to three Hub Discs and two 6" Circular Plates, and carries inside it a Meccano Electric Motor with which the whole mechanism is operated. The Motor draws its energy from a Meccano 8-amp. Accumulator installed inside the water-tank on the tender. As in the prototype, the two cylinders are arranged vertically and are half inserted in the top of the boiler.



George Stephenson's "Rocket," by N. C. Bowron (awarded Prize)

Each of the two piston-rods is attached to a transverse beam, the ends of which are connected to the driving wheels by 12½" Strips. Rocking arms for the beams are carried on a suitable frame consisting mainly of Angle Girders bolted to the top of the boiler. Other interesting features of the model include firedoor, manhole, bell, safety-valve, handle for starting and reversing, and a boiler feed pump.

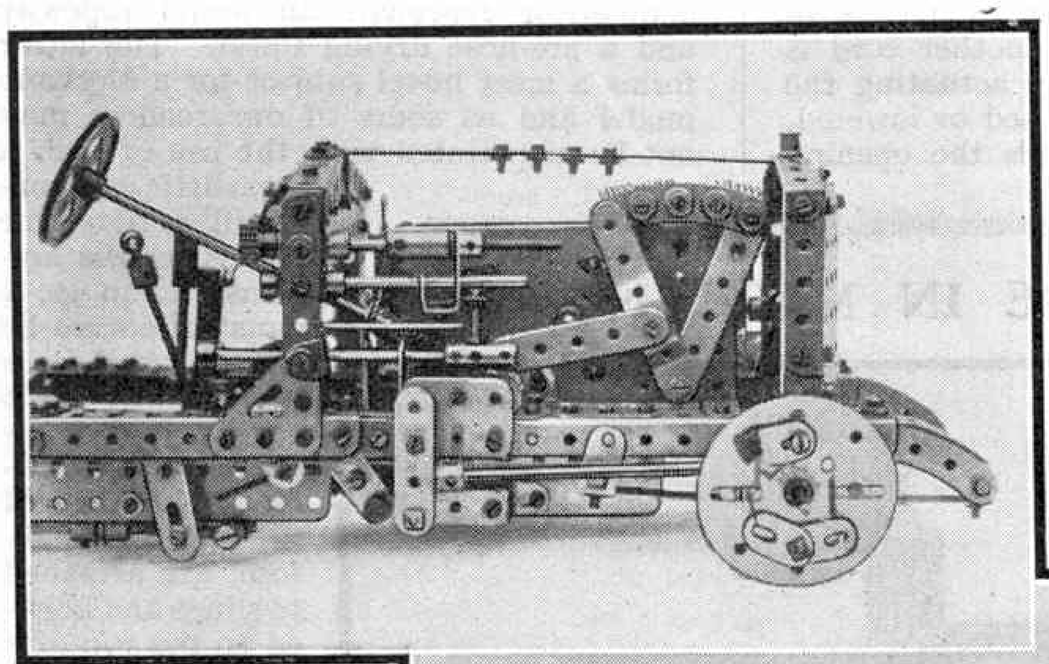
Lyn Holman and N. C. Bowron are the other competitors who submitted models of early locomotives, and both secured prizes. The former competitor chose for his subject Trevithick's first locomotive, while N. C. Bowron submitted the clever reproduction of George Stephenson's "*Rocket*" shown on this page.

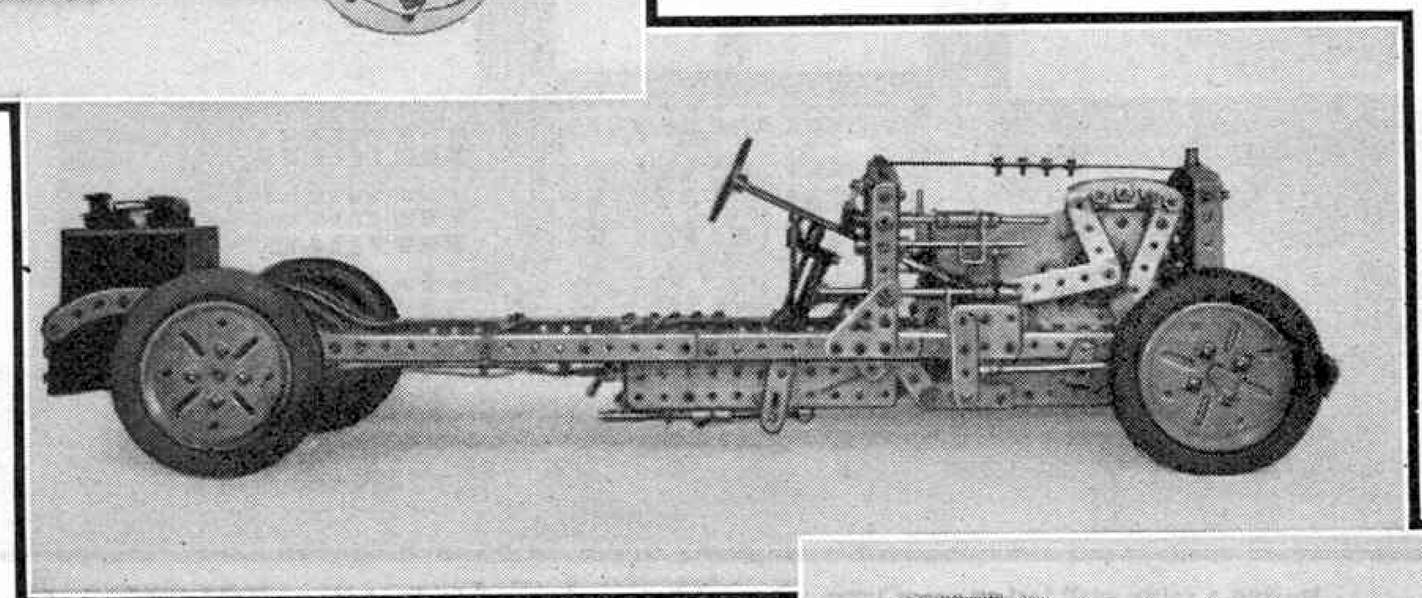
I hope many other Meccano boys will be induced to start this kind of model-building, for the reconstruction of objects of great historic interest and value affords a very instructive, as well as fascinating, pastime.

The Second Prize was won by E. J. Wright, who sent in a magnetically-operated beam engine. This is a very ingenious model and as a guide to readers who wish to construct similar models for themselves, I shall give a few details of its construction. Two bobbins, mounted one above the other, are wound with as many layers as possible of 26 S.W.G. insulated wire. The current is caused to flow alternately around the upper and lower bobbins, and a short Meccano Rod is drawn thereby first into one and then into the other. The centre of this Rod is secured in the end of a horizontal Coupling, which is suitably connected to the main beam above, and the movement of the beam is caused to operate the crankshaft.

A strip actuated by the crankshaft carries a contact piece (a 1" Screwed Rod) which makes electrical connection alternately with two Curved Strips suspended from overhead pivots. This action is used to magnetise the coils one after the other. Power is applied for about 70 per cent. of

the revolution of the crankshaft, the current being completely cut off before the crank reaches each dead centre. I hope to have this model reconstructed in our Model-building Department shortly, so that illustrations and full particulars can be published in the "*M.M.*"



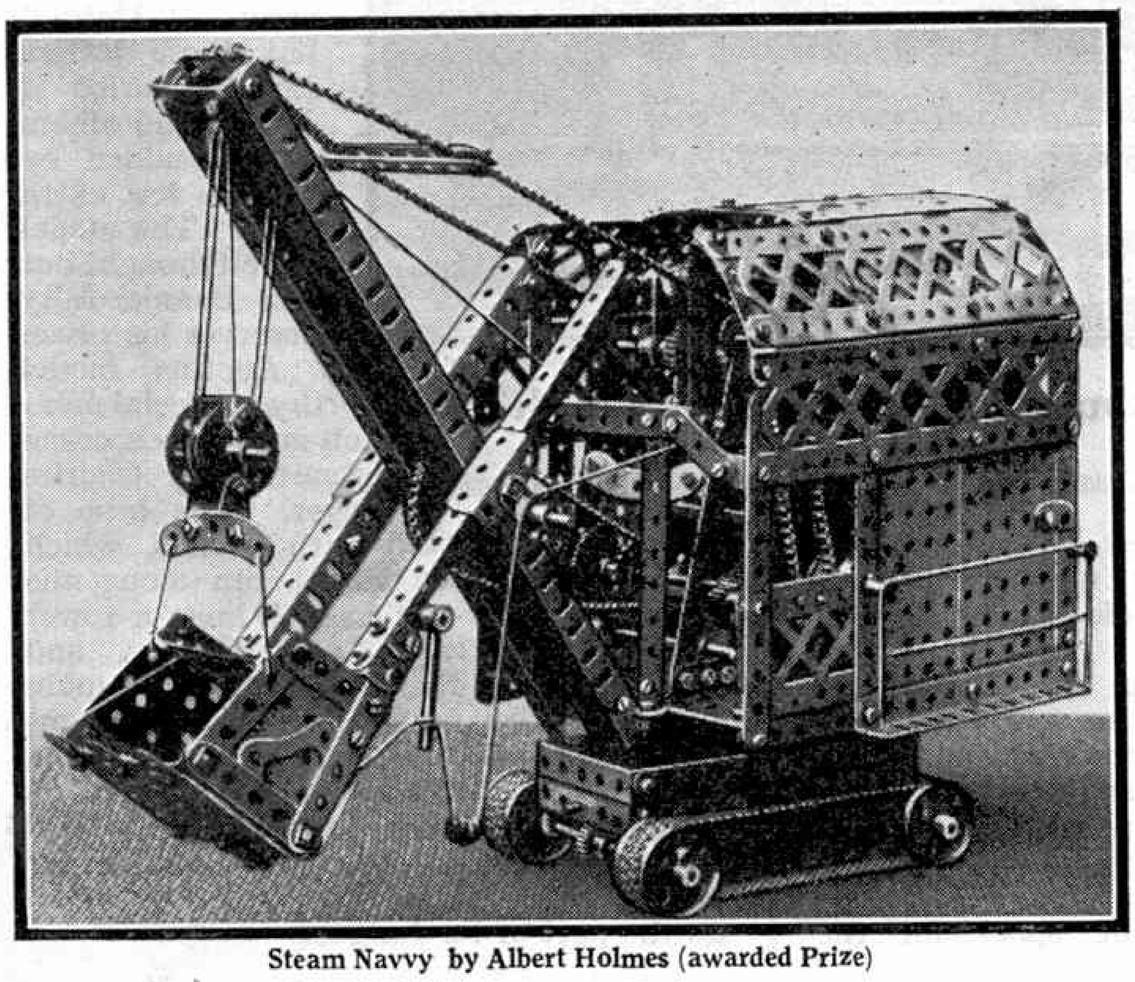


C. K. Kernahan's Prize-winning Motor Chassis (centre). Above : view showing engine and details of accelerator, front-wheel brakes, etc. Below : Engine and gear-box unit, showing clutch and hand levers, etc.

An Excellent Motor Chassis

The motor chassis with which C. K. Kernahan secured Third Prize is a remarkable piece of work, and is evidently the outcome of much thought and patience. From the three views shown herewith it will be seen that the chassis embodies many novel features. Its designer has, in fact, anticipated several of the improvements embodied in our own new model, the description of which is commenced on another page in this issue. Amongst these improvements I may mention the unit construction of the engine, clutch, and gear-box (shown in the lower illustration), the addition of a radiator cooling fan, and the design of the specially-shaped frame, etc.

A novel feature of Kernahan's chassis is an accelerator, which has both foot and hand control. It consists of a variable resistance comprising a short length of coiled resistance wire secured at four or five points to the shanks of insulated bolts mounted on a Curved Strip, which may be seen just behind the radiator in the top photograph. A 3" Strip is so arranged that it can make contact with the head of any one of these bolts, but it is normally held by a short piece of Spring Cord in such a position that the whole of the resistance is in series with the Motor. On operation of the accelerator pedal, the 3" Strip makes contact successively with the heads of the bolts, thus gradually decreasing the resistance and allowing more power to be supplied to the Electric Motor. Other important points in the model include a new gear-box and differential and fully-enclosed internal expanding brakes on all four wheels.



Steam Navvy by Albert Holmes (awarded Prize)

The excellent steam navvy shown in another illustration is the work of Albert Holmes. It is provided with two Clockwork Motors, one of which raises the shovel and operates the caterpillars, while the other racks the arm of the shovel in and out and rotates the whole machine on its base. A very interesting feature of the model is the incorporation of the Meccano version of the Constantinesco Torque Converter, which was fully described in recent issues of the "*M.M.*" Holmes tells us that, on test, the steam navvy lifted an oil-stove weighing nearly three times as much as the model itself.

A most interesting Meccano electric flashing sign was sent in by S. Mitchell. Models of such a type are rare, unfortunately, and as this is a very good example I feel that Mitchell fully deserves his award. Briefly, the model consists of a series of large radius 2½" Curved Strips mounted on Bush Wheels that are secured to a Rod driven by a Meccano Electric Motor. Short flexible strips of brass insulated from the frame of the model are each connected to a lamp and make contact with the rotating Curved Strips one after the other, thus completing the circuit to each lamp.

The model spells out the word "Meccano" letter by letter in the way familiar to most of our readers, and then the whole blacks out, to recommence afresh. This continues for as long as may be desired. There is very little in the mechanism that is likely to get out of order, however long the model may be in operation.

Miss P. Aspinall's entry is a very interesting model of a sixteenth century mill, complete with mill-stones and a "pilot vane" that is mounted on a wheeled carriage and geared to the mill so that it maintains the sails of the latter always in the face of the wind.

E. W. White secured his prize with a rigid six-wheeled motor omnibus chassis, the mechanism of which comprises many original features. The two driving axles are attached to the ends of semi-elliptic springs in the rear of the chassis, and are driven by means of Sprocket Chains from a central driving shaft embodying the differential.

The "Switchdip"

W. A. Barham's prize-winning entry consists of an apparatus which its owner has very aptly named the "Switchdip." It resembles the familiar "switchback," and is entirely self-acting. A small car is carried in an elevator (operated by an Electric Motor) to the top of a tower, where it is automatically pushed on to a set of inclined rails. After running down these rails it is transferred by means of a pivoting end rail to a lower track that returns it to the elevator (which has meanwhile descended to the bottom of the tower) and the operations are repeated. The upper rails are disposed in a series of curves and dips, which ensure a hectic time for anyone rash enough to venture into the car!

Overseas "No. 3 Outfit" Contest Results

As in the Home Sections of this Competition, the judges found it impossible to select the principal prize-winners from a number of entries in the Overseas Section, and they decided, therefore, to combine the three main prizes and to distribute them equally amongst six competitors. The names of the prize-winners are as follows :

SIX PRIZES, each of Meccano products to the value of one guinea : R. Galvin, Bulawayo, S. Rhodesia ; Kevin F. Dwyer, New Town, Tasmania ; Peter Rex Spencer, Kooringa, S. Australia ; J. Tanner, Annandale, Sydney, N.S.W. ; O. Sanderson, Johannesburg ; T. Cook, Durban.

SIX PRIZES, each of Meccano products to the value of 10/6 : E. Bonnici, Valletta, Malta ; Gordon Bartlett, Milton, Brisbane, Queensland ; F. Stoakes, Hong Kong ; C. Roger, Paris ; P. T. Hewitt, Geneva ; E. Brookfield, Buenos Aires.

SPECIAL COMMENDATION (Certificates of Merit) : Frederick G. Glass, Garanhuns, Brazil ; F. Van Bulck, Paris; Chand Mal, Delhi, India ; S. Falkof, Johannesburg ; C. F. Stoltz, P. O. Estantia, Transvaal ; M. Coughlan, Palmerston North, New Zealand ; L. Peris, Slave Island, Ceylon ; P. N. and R. Hastings, Madrid, Spain.

Six-year-old Prize-winner

Peter Spencer secured his prize with a model tank locomotive. This is a particularly noteworthy entry in view of the fact that Peter was only 6½ years of age when he built the locomotive. Another interesting entry that secured one of the principal awards was in the form of a Fokker military biplane, constructed by R. Galvin. Even without any covering on the wings or fuselage, the model has a very realistic appearance. The propeller is rotated by a Meccano Clockwork Motor fitted into the fuselage.

Kevin F. Dwyer submitted models of a floating steam grab dredger and a transporter bridge. The dredger is fitted with a particularly ingenious grab mechanism. The grab itself consists of two jaws made from cardboard, to the upper edges of which 2½" Strips are bolted. These 2½" Strips are pivoted together in the centre of the grab and a cord is attached to the pivot. Two pairs of 3½" Strips are attached to the outer ends of the 2½" Strips, and their other ends, meeting vertically above the centre of the grab, are pivoted together by means of bolts and lock-nuts, and another cord is attached to the joint. By actuating the second cord the grab is raised or lowered, while the first cord controls the opening and shutting of the jaws. The remainder of the dredger is built in a workman-like manner, and the whole forms a very fine model.

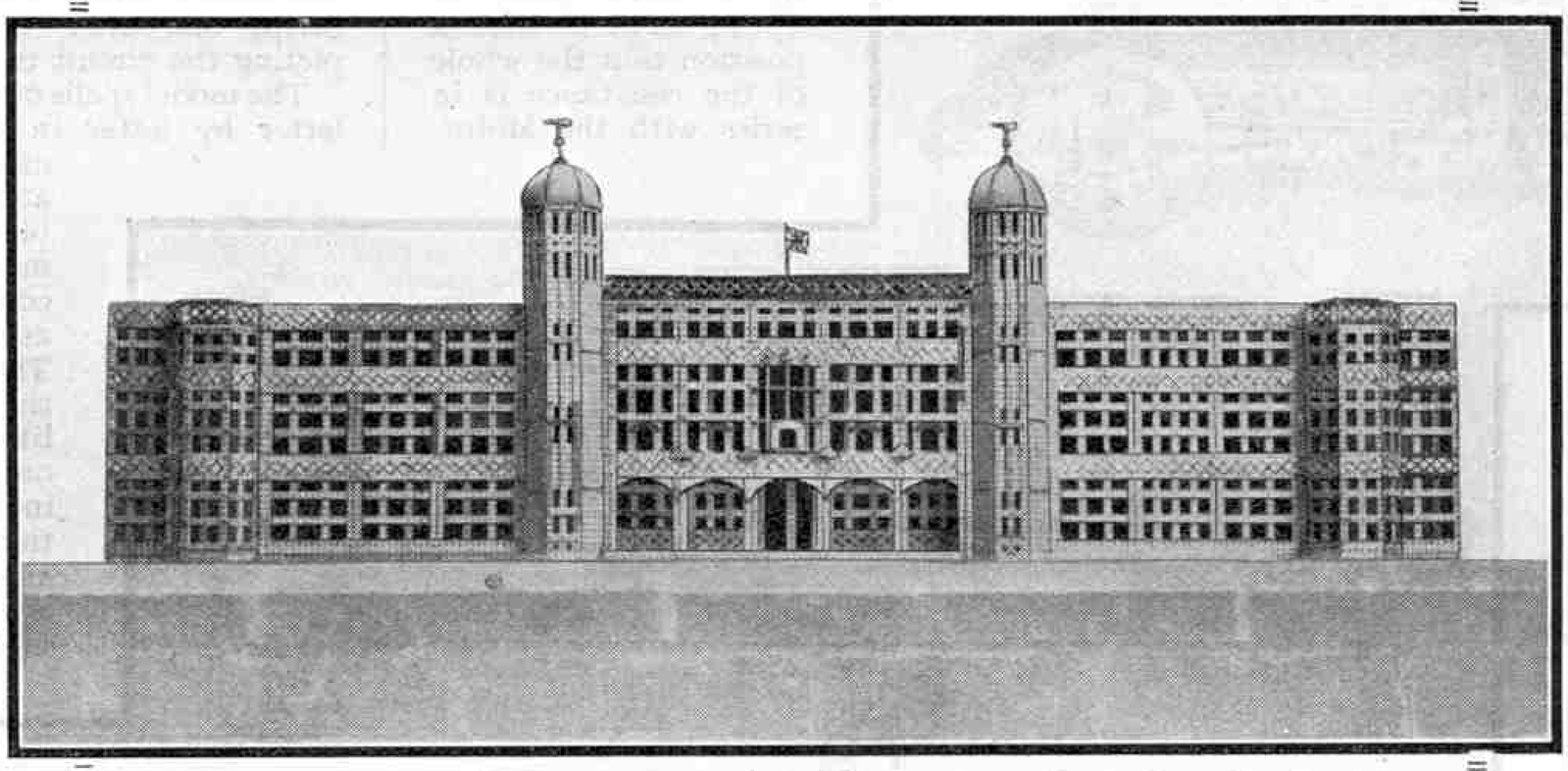
Another enterprising competitor was J. Tanner, who sent in no less than three models, each of novel design. One of the models represents a gangster's trolley of somewhat similar design to the velocipede described in the September "*M.M.*" Tanner's model is of a somewhat larger type, however, allowing space for the conveyance of materials, and, as in the case of the velocipede, it is propelled by the manipulation of a hand lever placed near the rear of the trolley.

The other models submitted by this competitor represent an aerial ropeway and a fire-hose drying tower. The latter forms a most novel subject for a Meccano model and as some of our readers may not be acquainted with the use of such a device a little explanation will perhaps be useful. After the fire-hose has been in use it must of course be dried, for if it is stored away while still damp the canvas will rot quickly. The lengths of fire-hose, therefore, are attached to slings and hoisted to the top of a tower and left until dry. The model consists of a suitable framework built up from Angle Girders, at the top of which two Pulley Wheels are mounted, and cords passed over these wheels are wound on to a Rod at the base of the tower. This Rod is rotated through gearing from a Crank Handle and its motion is controlled by a Pawl and Ratchet Gear. To the free ends of the cords are attached slings consisting of 1½" Rods and Spring Clips, which carry the hose-pipes up the tower.

A very ingenious model of a typewriter was submitted by E. Bonnici. Its use is somewhat limited, of course, for it will only type the word "Malta," but these letters can be varied if desired and others can be added by using a few extra parts. The model is well thought out and Bonnici fully deserves his prize.

Another model worthy of special mention is the dock crane submitted by Charles Roger. The base of the model is fitted with wheels, which in actual practice would run along the dock side. On this base is built a tower consisting of 12½" Angle Girders, and to the top of this is pivoted the main boom of the crane. The model comprises three movements, namely, hoisting, traversing movement of the trolley on the horizontal boom, and swivelling. Its appearance is most realistic and bears witness to ingenuity and constructive skill on the part of its designer.

STONYHURST COLLEGE IN MECCANO



During a rainy spell last summer term, when cricket was impossible, the boys of Hodder (the Preparatory School of Stonyhurst College) constructed a Meccano model of the centre block of the South, or Playground, Front of the College. The upper photograph shows that their efforts met with complete success. The South Front of the building measures 550 ft. in length, 270 ft. of which are occupied by the centre block. In the construction of the model, which was built with the aid of photographs, the boys used 1,200 Nuts and Bolts, and when completed the structure measured 9 ft. in length. In order to obtain greater realism the cupolas on the towers were constructed from cardboard. The similarity between the model and the actual building will immediately be apparent on comparing the photographs reproduced on this page. The lower photograph shows the entire South Front of Stonyhurst College, and the centre portion, which formed the subject of the Meccano model, is indicated clearly.

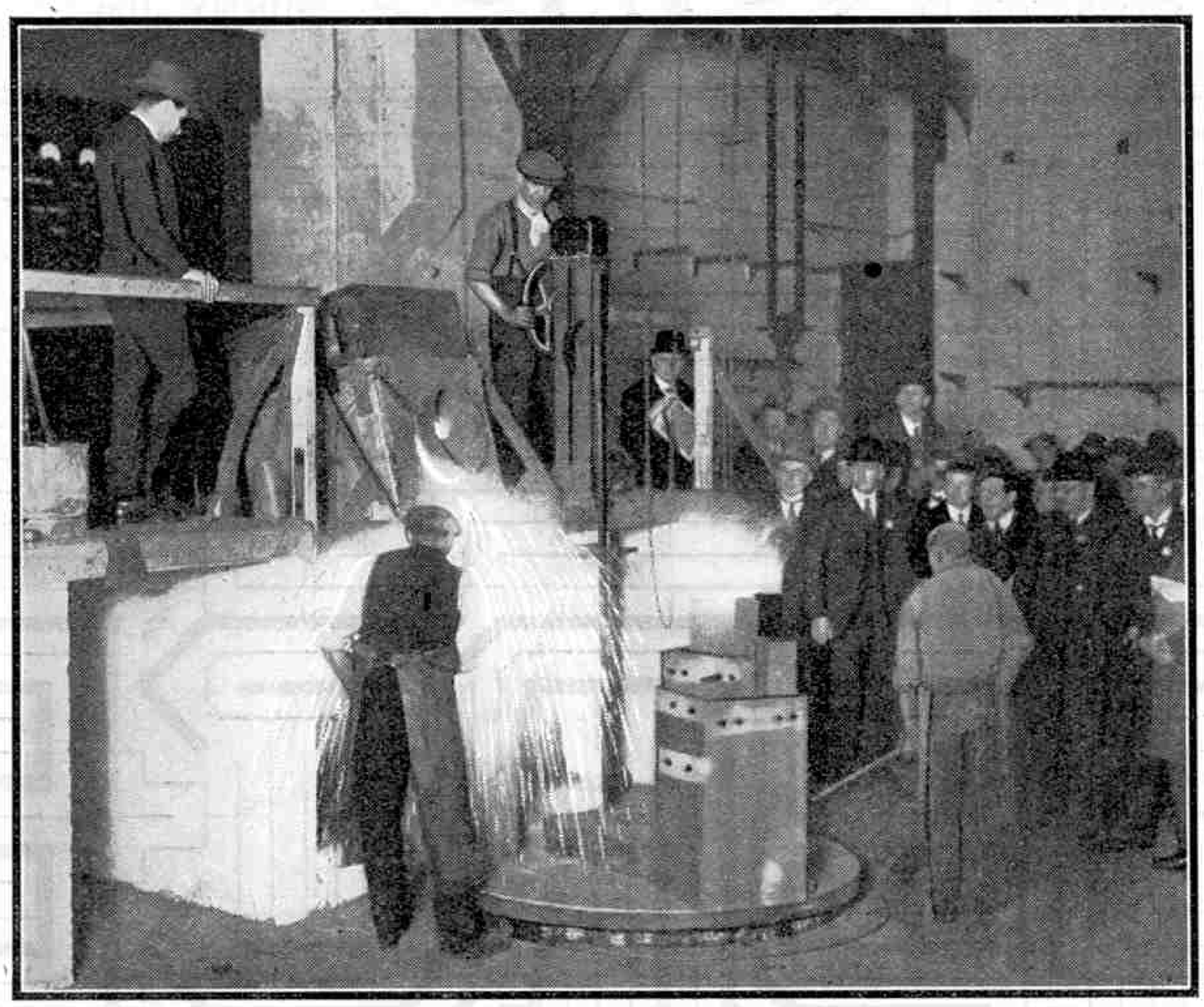
Stonyhurst College, near Blackburn, as seen from the south

Wonderful New Furnace

For Making Crucible Steel

A REMARKABLE electric furnace of an entirely new type has been introduced by Edgar Allen & Co. Ltd., the well-known Sheffield steel makers. Knowing the keen interest that readers of the "*Meccano Magazine*" take in all matters of this kind, the firm invited us to send a representative to see the furnace in operation in their Crucible Steel Department. As a result of their courtesy we are able to give our readers an account of one of the most recent applications of science to industry.

Sheffield has long been known as a centre of the steel trade and since 1740 it has been specially famous for the high quality of its tool steel. In that year a great advance was made in the method of manufacture by Benjamin Huntsman, a Sheffield clock maker, who became dissatisfied with the quality of the steel of his clock springs. At that time steel was made from bars of Swedish wrought iron by packing them in airtight vessels with charcoal and subjecting them to a high temperature for from eight to twelve days. When the bars were removed from the furnace they were covered with blisters, and the material was therefore known as "blister" steel. The blisters were flattened out by hammering lightly and the bars were welded in a furnace into a solid mass.



A furnace in a box: the new Electric Furnace pouring crucible steel at the special demonstration described on this page

The great difficulty with this steel was that it contained "weld lines," and Huntsman realised that it would be a great improvement if steel of uniform quality could be made without a welding process. After many experiments he hit upon a method that even now remains the best method for producing high-class steel. He did not patent his process, but preferred to keep it secret, and with this object he carried on work only at night, with a staff of men all sworn to the strictest secrecy. The other Sheffield steel-makers became alarmed at Huntsman's success, and they determined to find out the details of his process.

One cold and stormy night a certain iron-founder disguised himself as a tramp and knocked at the door of Huntsman's works, begging for shelter. The workmen took pity on him and gave him a warm corner near the furnace, where he pretended to go to sleep. He was really very wideawake, however, and as the men went on with their work he took careful note of the construction of the furnace and of the manner in which the process was carried out. Some hours later the tramp thanked the workmen for their kindness and left, taking with him Huntsman's cherished secret.

Even though nearly 200 years have passed since its introduction, Huntsman's process continues in use for the production of the finest tool steel, although it is long and laborious. First of all crucibles are made from a special clay, which is kneaded with water and a little coal-dust by men who trample on the mixture for five or six hours. The moulded crucibles are dried for 10 or 14 days in a heated chamber and annealed at a red heat. The charge is then prepared. This consists of broken pieces of brittle blister steel and a small quantity of scrap, the proportions being carefully arranged to produce a steel of the desired composition. The crucibles are placed in the furnace, which is sunk below floor level, and the charge is then inserted. Special metals such as tungsten, chromium, and vanadium are added to the crucibles as required during the melting process, according to the nature of the steel that is to be produced. After about four hours the crucibles are lifted out of the furnace by a workman who in order to carry out this task, must stand within close range of the terrible heat. The metal is then poured out into moulds and subsequently passes through rolling and annealing processes. An enormous amount of strength and physical endurance is required of the men who operate Huntsman's process and even to the sturdiest men the work is extremely exhausting.

The new process entirely abolishes all discomfort and physical strain. It is carried out by means of what is known as the Ajax-Northrup high-frequency furnace, which makes use of high-frequency currents in a manner never previously attempted on a large scale. The steel is contained in a refractory crucible, which is surrounded by an inch of heat-insulating sand. Around this is wound a water-cooled metal coil and the whole is built into the body of the furnace. The coil carries the high-frequency electric current.

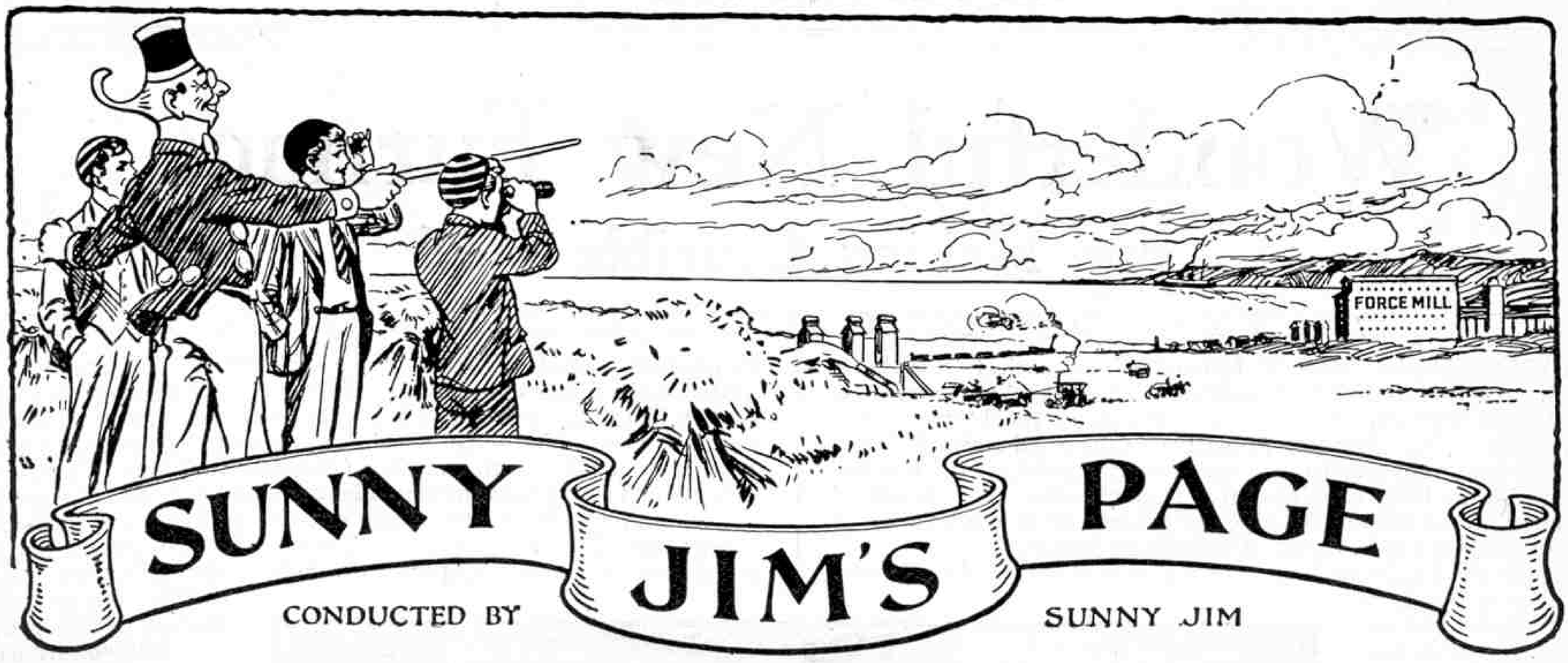
The metal itself plays an important part in the heating process for the current that raises the temperature flows through it alone. The heating is not produced by the high-frequency current itself but results from "eddy currents" set up by induction. The passage of a current of electricity through a coil of metal always induces stray currents in adjacent pieces of metal, just as it induces currents in the secondary coil of a transformer. These stray currents are known as "eddy currents." In transformers with iron cores these eddy currents are not wanted and they are checked by building the core of laminations insulated from each other. In the Ajax-Northrup furnace, on the other hand, eddy currents are deliberately encouraged in the mass of metal in the crucible.

The furnace body must be of some non-conducting material in which eddy currents cannot be induced and, as the heat insulation prevents heat from passing outward from the furnace itself, wood is the most convenient material of which to make the body. In spite of the enormously high temperature of the molten steel in the crucible, the wood forming the body of the furnace does not become perceptibly warm.

The necessary high-frequency current for the process is supplied by a motor generator that has been specially designed to supply the exact type of current required. The electrical plant is completed by a switchboard with the usual control fittings.

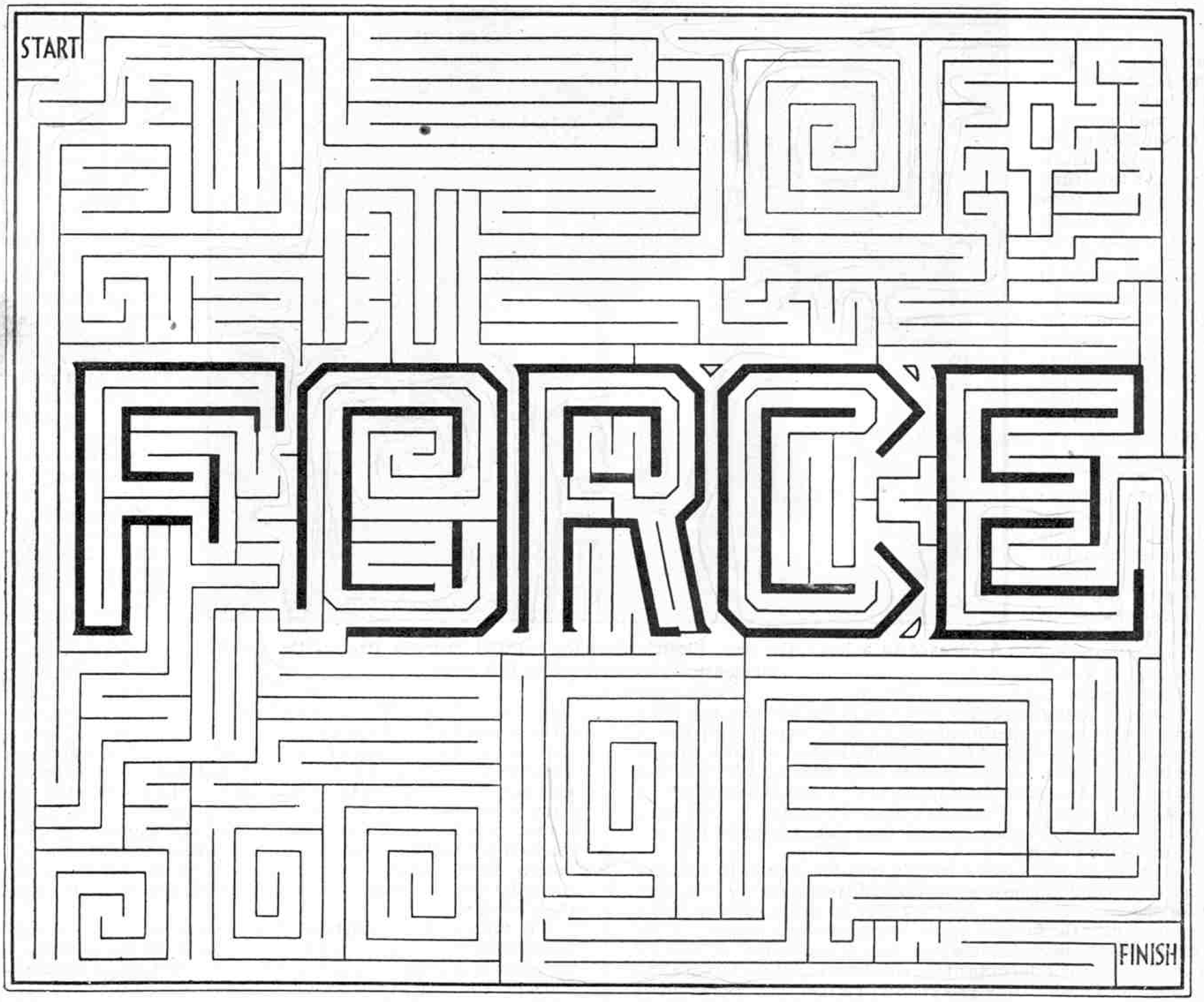
In addition to eliminating the laborious conditions of the Huntsman process, the new method has many economic advantages. It is estimated that it will operate at an appreciably lower cost per ton of steel produced, although this

(*Continued on page* 70)



SUNNY JIM'S PAGE

CONDUCTED BY SUNNY JIM



WHO CAN CROSS QUICKEST?

Here's a test of skill for you and your chums. Get two or three of your friends together, and give a pin to one of them. Tell him to trace with it a course from the place marked "Start" in the diagram above, to the "Finish" in the bottom right-hand corner.

At the word "Go," time him with your watch, and record the whole time taken. Deal with each friend in the same manner, and have a "go" yourself. You will be surprised to see what varied times will be registered. The winner, of course, will be he who completes the distance in the shortest time.

A race like this does not call for physical energy, but mental alertness is very necessary. Those of you who eat "Force" will know of the benefit, both physical and mental, that comes from the use of this inimitable energy generator. You who are reading this page should know, every one of you, what a fine food "Force" is.

Candidly, until you taste it, you can have no idea what a treat you are missing. Yet a word in the right quarter would bring you this rare feast every day. Ask for "Force" for breakfast—then try it at supper too! Eat "Force" with hot milk in cold weather.

Competition Page

A NEW SHARP EYES CONTEST

The popularity that has attended our recent advertising competitions leads us to follow up with something of a similar nature relating solely to the "*M.M.*" Practically every reader who proposes to enter this competition will possess a copy of our special December issue; those who were unfortunate enough to have missed this must beg, borrow or steal a copy if they wish to take part!

Below we set a number of questions, each of which relates to an advertisement that appeared in our December issue. The actual phrase or statement quoted will be found to occur in the advertisement from which it is taken. For example, suppose one of the questions to be —Who have manufactured for 30 years? Competitors then must go through the advertisements very carefully until they find an advertisement in which this statement is made. The answer to the question is Hobbies Ltd., who, on the inside front cover, inform our readers that they have been engaged in making fretwork outfits for over 30 years.

Those readers who imagine this competition will prove easy will find after tackling the first two or three questions that it is not quite so simple as it appears! Here are the questions:—

1. 3 for 3/6. What and where?
2. Will turn left or right. What is it?
3. What "*M.M.*" advertised product is sold by grocers?
4. Secured by one bolt only. What?
5. What is made in two models?
6. 25 coloured plates. Where are they?
7. 8 for 1d. What?
8. An all the year round toy?
9. Whose demonstrators will be delighted to answer questions?
10. Entertains the whole family. What?
11. What runs for half-a-mile on one filling?
12. Fitted with Dunlop Cord balloon tyres. What?
13. What is absolutely safe in working?
14. What has a force feed?
15. What is fitted with a telegraph key?
16. 28 in. in length. What?
17. 88 pages free. What?
18. Warranted for 10 years. What?

The solutions should be numbered from 1 to 18 to correspond with the order of the questions, and must give the name of the actual article or advertiser indicated by the question.

Prizes of Meccano products to the value of £1/1/–, 15/–, 10/6 and 5/– respectively, will be sent to the four competitors who submit the most accurate solutions and, in addition, there will be a number of consolation prizes. Readers are asked particularly to see that their name and full address appears on the entry, which must be addressed to "Queries, Meccano Magazine, Binns Road, Liverpool," and sent to reach this office not later than 31st January. Overseas closing date 30th April.

Railway Planning Contest

In response to many requests from readers who are railway enthusiasts we announce this month another railway competition. There are few more fascinating pastimes than the planning of a model railway to obtain most interesting results from a certain quantity of material. In the present competition entrants are to imagine that they have at their disposal Hornby engines, rolling stock, track, etc., to be used in the construction of a complete model railway suitable for a room measuring 12 ft. by 18 ft.

The layout may be of any type provided that the following conditions are fulfilled:—(a) there must be two terminal stations and one wayside station; (b) each terminus must include an arrival and a departure platform complete with facilities for engines to be released from their trains immediately on arrival by means of a running-round line.

Competitors are free to decide what material they will employ, but the total value must not exceed £10 and each entry must include a detailed list showing how this total is reached.

Prizes of Meccano products to be chosen by the winners to the value of £1-1-0 and 10/6 respectively will be awarded to the best entries in each of the usual Sections—A for those aged 16 and over and B for those under 16. Competitors should note that their name, address and age must accompany each entry, which must be addressed "Railway Competition," Meccano Magazine, Binns Road, Liverpool.

Closing date 31st January. Overseas 30th April.

"A Trip to Canada"

During recent months we have published in the "*M.M.*" a number of articles dealing with life and scenes in Canada. It occurs to us that many of our readers must have formed in their minds a very definite idea of what they might expect to see if they were able to visit Canada, and we announce this competition with the object of learning something of our readers' impressions.

The competition is entitled "£50 AND A TRIP TO CANADA; WHAT I SHOULD EXPECT TO SEE." Competitors are asked to imagine that they have been given a £50 note and a free travel ticket to Canada. From that point they must go ahead and tell their imaginary experiences.

Canadian readers, in order that they may have an opportunity of entering in the Overseas Section of the contest, should reverse the trip and regard the competition as being entitled "£50 AND A TRIP TO ENGLAND; WHAT I SHOULD EXPECT TO SEE."

Prizes of Meccano products to the value of £1-1-0 and 10/6 respectively will be awarded in Section A, for readers age 16 and over and Section B for those under 16. In addition to these prizes there will be awarded as Consolation Prizes 50 copies of a most interesting book entitled "THE STORY OF THE CANADIAN PACIFIC RAILWAY." These books are being presented by the C.P.R. and only 50 are available.

Entries should be addressed "Canadian Essay," Meccano Magazine, Binns Road, Liverpool, and must reach this office not later than 31st January. Overseas closing date 30th April.

Overseas Results

Cover Voting Competition

The final order of voting in this section of the Cover Voting Contest was as follows:—February, April, August, December, October, June, May, July, March, November, January, September. No boy succeeded in giving a completely accurate forecast and the prizes were awarded to the following:—1. H. TSUMURA (Tokio, Japan); 2. W. F. KALER (Otago, New Zealand); 3. L. FISHER (Johannesburg); 4. B. K. CHOKSI (Karachi, India). Consolation Prizes: J. H. BOLTON (Cape Town, S.A.); L. FAGG (Otago, N.Z.); F. HEDGER (Wellington, N.Z.); A. M. THOMSON (Queensland, Australia).

Competition Suggestions

First Prizes: Section A, T. WALSH (Sydney); Section B, J. EVANS (Victoria, B.C.). Second Prizes: Section A, N. THOMPSON (Cape Town); Section B, B. R. MATTHEWS (Melbourne).

Slogans

First Prize: H. T. SAUNDERS (Alberta); Second: H. C. KEY (Calcutta); Third: L. S. WENG (Malacca); Fourth: N. F. KEITH (Victoria). Consolation Prize: DAPHNE POOLEY (Brit. Columbia).

31st Photo Contest

First Prizes: Section A, K. LANGSDORF (Queensland, Australia); Section B, E. BONNICI (Valletta, Malta). Second Prizes: Section A, R. DUBOIS (Paris); Section B, J. D. REID (Yootak, S. Australia).

23rd Drawing Contest

First Prizes: Section A, E. HOLDER (Trinidad, B.W.I.); Section B, R. S. JONES (Sydney). Second Prizes: Section A, D. SHORES (Winnipeg, Manitoba, Canada); Section B, R. MACDONALD (Toronto). Consolation Prize: R. MACLEAN (Victoria, Australia).

Other results are unavoidably crowded out. The prize-winners have been notified by post.

SOME PRIZE-WINNING MECCANO COSTUMES

Go as a Meccano Boy!

Boys—and girls too—attired in costumes representing "Meccano," have been so extraordinarily successful in winning prizes at Fancy Dress Carnivals in past years that we have thought it desirable to reproduce photographs of a few of them. No doubt the ideas shown will be helpful to those readers who contemplate taking part in Fancy Dress Carnivals during the present season.

We are always pleased to send suitable advertising material to those who wish to make Meccano costumes and to hear of new ideas in this connection.

Exploring the Arctic—(*continued from page* 17)

among the Eskimos during a stay of more than five years in Boothia and near the mouth of the Great Fish River.

Among other Eskimos he met an old man called "In-nook-poo-zhee-jook," the very man who gave Rae his information regarding the white men who died in the West. Much of the information obtained by Hall from this man and others was very confused and it cannot be said that he learned much of value. All that he saw for himself was a part of a human bone found on a small island north-west of Point Ogle and a skeleton discovered by an Eskimo companion on King William Land. An interesting fact elicited by Hall that seems to be well established is that either the "*Erebus*" or the "*Terror*" drifted as far south as the coast of the American Continent after being abandoned.

Hall's five years' sojourn in the Arctic seemed to dispose finally of any possibility of the existence of survivors of Franklin's expedition. He returned in 1869, and nine years later still another American resolved to explore King William Land in the hope of finding more Franklin's records. This was Lieutenant Schwatka, of the United States Army, and his journey is notable in that he relied on the country itself for his food. On leaving Hudson Bay he carried with him only one month's supply of food, but an abundant supply of rifles and ammunition. He spent the entire summer in searching King William Land. Several graves, skeletons and wrecks of boats were discovered, but nothing of any further importance.

These efforts finally brought the search to an end. It had failed in its first object of rescue, but the many expeditions it had called forth had led to great advances in geographical and scientific knowledge. Not the least of the benefits resulting from the great activity was the development of sledge travelling. This mode of progress was forced on M'Clintock and others by the necessity for examining large extents of coastline that could not be reached by ships except in specially favourable seasons and, as we shall see in later articles, it became the standard method of Arctic travel.

Wonderful New Furnace—(*contd. from page* 67)

cannot be definitely proved until the furnace has been in operation for some time. Another advantage is that the buildings and plant required are on a much smaller scale than is possible in the old crucible process, and at every stage of the process the metal is under control.

The steel produced in the Ajax-Northrup furnace is of great purity. As the steel does not come in contact with the fuel or with the gases evolved in the Huntsman process, it is remarkably free from substances such as sulphur and phosphorus, which detract from the value of the metal. In addition, ingots of steel required to conform to a special analysis may be produced very quickly.

It is possible also to melt up larger quantities of metal at one operation than is the case with the old crucible process and the ingots produced are therefore of more uniform quality. Finally, it is a very important advantage that the temperature of the molten metal is much more under control and can be adjusted at any time as may be found necessary.

Making "Scenery" out of Sound

"Two short pieces of wood covered with sandpaper ; a flour sieve ; a pair of roller skates ; a metal plate ; a whistle ; a bell and two pieces of heavy cord."—*The best recipe for a fast train!*

NOT the least important personage in the broadcasting studio is the man who builds "scenery" out of sound. It is not enough, in the production of a play by wireless, merely to announce at the beginning of an act that the action takes place indoors, or outdoors, or on the shore or in the woods. The listener must gain his mental picture of the setting from the lines of the play and from supplementary sounds.

These sounds are usually produced by the use of "props," but sometimes the most striking effect is gained by importing the sounds from the scene depicted. For example, a short time ago the B.B.C. placed a microphone at a busy London street corner and produced these sounds as a background for the lines of the playing cast. This method is not always possible or convenient, however, as in the case of a forest fire! At WGY, the famous broadcasting station at Schenectady, New York, some time ago a most realistic forest fire was created by the use of a plumber's blow torch for the sound of flame and wind and by breaking matches to simulate sound of the crackling of burning tree limbs.

Courtesy] [*General Electric Co. of America*

The Main Studio of WGY, the famous broadcasting station at Schenectady, New York

Since the listener is unable to see anyone enter a scene, the character's presence is generally denoted by the closing of a door or by the lines. For this reason the doors in all the homes of the radio drama characters are apt to be squeaky affairs and the slamming of doors, which has won many a boy or girl a corrective word from parents, becomes a necessity!

The production of sound scenery is the most difficult problem in the radio drama, more particularly so because the obvious sound is not always the most suitable to produce a certain effect. Hours and hours are sometimes devoted to devising an accurate sound production. Then after the "props" necessary to create the sound have been found or built, radio rehearsals must be held in co-operation with radio engineers. The stage "prop" is very rarely suitable for radio use, although the wind and thunder machine of the stage can usually be used for a storm effect. Although on the stage "prop"-produced noises are often poor imitations of the real thing, the radio microphone is so sensitive that much closer attention is necessary if the passing train is to sound like a train and not like a noisy motor-cycle or a wheezy tug boat.

This subject, the production of the sound of a speeding express train, presents one of the most difficult "sound" problems that has to be faced. The director responsible for sounds must first study the sounds of railway trains and after he has satisfied himself that he has learned all the sounds in their correct sequence, he must tackle the problem of producing those sounds so faithfully in the studio that the listener many miles away will know that he is listening to the passing of a locomotive-drawn train.

A real locomotive whistle helps enormously and boards covered with sandpaper can be made to produce what may be described as the "chig-chug" of the engine when rubbed one against the other and a flour sieve helps to define the sharp first sound heard as the engine puffs. The problem of producing the roar of the passing train and the pounding or bumping of the wheels on uneven track, which was the effect desired in one particular case, is nearly as easy. A metal panel, five feet in length was decided upon for the track. A couple of youngsters on roller skates speeding over an uneven surface on the studio floor suggested the rolling stock, and a pair of roller skates was utilised as a train. In the first rehearsal, a couple of heavy cords were stretched over the metal panel. At the roller skates passed over the panel it was impossible to distinguish the sound from that of a train bumping over uneven rails.

The listener first heard the distant whistle and the muffled roar, the volume being gradually built up in the control room until the effect was obtained of a heavy train thundering past a little country railway station. An added effect, familiar to those who live near passing trains, was the rattling of window glass.

Six people were required to produce the train effect, one to whistle, one to "chug," one to operate the roller skates, one to make the windows rattle and another to sound the bell and the sixth, the control room operator to control the sound volume. And after only one rehearsal the illusion was complete!

"Wanted—an Idea" Competition Results—

(*Continued from page* 61)

here that many readers suggested that the book should be connected directly to the switch knob, but it must be remembered that if this idea were adopted, the required results would be obtained only if a particularly heavy book were used, or an extra weight were attached to the cord. Either method would tire the reader in a short time.

The model sent in by P. J. Simon of Holt, Norfolk, although of more complicated construction, approached most closely to the principle embodied in Fig. A, and the judges decided therefore to award this competitor a prize consisting of Meccano products to the value of one guinea. Instead of having the weight hanging free, Simon constructed an inclined tray to support it. The weight is prevented from falling from the tray by a lever, to one end of which the book is attached by a length of string. When the book is dropped the lever is thrown up, allowing the weight to fall and so turning off the light.

Another particularly ingenious model was submitted by William Foster of Widnes, who will receive a special prize of Meccano products to the value of 10/6. Briefly, his solution consists of a lever on the end of which a small platform is attached. The lever moves about a fulcrum situated near the wall and a rod placed vertically under the switch knob just rests on the short arm of the lever. The reader must hold the book over the side of the bed and when he falls asleep the book drops on to the small platform on the end of the long arm of the lever. This causes the short arm to rise, pushing up the vertical rod which, in turn, pushes the switch knob into the "off" position.

A further prize, to the value of five shillings, will be awarded to D. Smith of Renfrew, for a very interesting solution to the problem. In addition, the following readers will each receive a Meccano Certificate of Merit, since their entries were specially commended by the judges:—Harry Rutter, Consett, Co. Durham; F. Williams, Basingstoke; A. E. Whitworth, Repton; J. King, Glasgow; D. Pieken, Prestwick, Ayrshire; Ernest Chester, Rochdale; H. G. Hicks, Gillingham.

Conquest of the Air—

(*continued from page* 23)

car sank in the water. During the first moment of alarm, we threw from us instruments, clothes, money and all that could lighten the machine; still we did not rise, so we cut away such portions of the car as could be spared, and finally threw our lamps into the sea. Thus lightened we rose with such extreme rapidity, that we could not hear each other's voices, even by hallooing. I felt sick, and Grasetti's nose bled; as we had been wet to the skin, we were now covered with a coating of ice.

"After spending half-an-hour in the upper regions, we descended slowly, and fell again into the sea. The night was still dark, and the sea tempestuous. . . We remained up to our waists in the water with the waves washing over us. The balloon being more than half empty, the wind used it like a sail. We remained in this plight during the long hours that intervened till dawn, when we found ourselves opposite Pesaro, about four miles from the coast. We thought we should soon arrive there, when a land wind again carried us out to sea. The few fishing-boats near made away from us in alarm; but a smack at a distance recognised our globe as a balloon and came alongside. The sailors threw us ropes by which means we reached the deck perfectly exhausted. Our aerostat, thus lightened again, rose in spite of all endeavours to restrain it, and was soon lost in the clouds. We were conveyed to Pola, where we were received in the kindest manner. I was, however, obliged to have two fingers amputated that had been frost-bitten."

The escaped balloon eventually descended somewhere in Turkey!

Creeping Rails—

(*continued from page* 39)

downward projecting portion having a face adapted to bear against the sleeper.

The second part of the anchor consists of a yoke made of a flat steel plate, a part of which extends transversely below the rail and is adapted to bear against the entire under side of the base of the rail. At each end of this yoke is an upstanding part shaped so that its upper end is a finger projected inward towards the centre of the rail. One of these fingers bears on the upper side of the foot of the rail and the other at approximately right-angles to the web of the rail on the upper side of the key. The finger of the yoke that bears on the foot of the rail opposite the key has a curved projecting end engaging with the rail flange.

When conditions arise tending to cause the rail to "creep" toward the sleeper, the curved projecting finger at the top of the yoke is inclined obliquely and thus its grip on the rail is tightened. At the same time an increased pressure is put upon the key, which is forced more tightly to the foot of the rail against the sleeper. The more the rail tries to creep, the more the yoke tightens its hold and the tighter the key is wedged against rail and sleeper, resulting in a firmly locked creep-resister. This rail anchor is designed for use with both bull-headed and flat-bottomed rails and with all kinds of sleepers.

Rail creep is one of the permanent way ailments that is little known to the travelling public, a large proportion of whom will be greatly surprised to learn that more than 66,000 platelayers are constantly at work to maintain that high standard of efficiency for which Great Britain's permanent way is justly famed.

A Schoolboy's Pocket Diary

(Charles Letts & Co. Price 1/6)

The Schoolboy's Pocket Diary for 1928 retains all the features that have made it so popular in past years and at the same time various new and interesting features have been incorporated. The earlier pages of the diary are packed with an astonishing variety of information ranging from Latin, Greek and French verbs to an attractive and comprehensive list of athletic records. Another notable section deals with careers for boys and the method of entering them.

A particularly interesting novelty in connection with the diary consists of a year's "Monomark" service for the nominal sum of one shilling. As most of our readers know, a Monomark is a short combination of letters equivalent to a permanent address. In Great Britain this consists of the prefix "BM/" followed by letters or numerals that identify the owner of the mark.

Whitfield King's 1928 Catalogue

Several improvements have been introduced in the 1928 edition of Messrs. Whitfield King & Co.'s stamp catalogue, principal among these being the use of numbers to facilitate the identification of illustrations. The addition of this feature renders this catalogue of even more value than hitherto to the young collector who is usually content with one specimen of any particular type. Here he will find only principal varieties listed.

A comparison of figures between the 1927 and 1928 editions shows that altogether 1,591 new stamps have made their appearance in the intervening period, the actual number of issues included in the catalogue being 46,969.

How to get more fun out of Hornby Trains

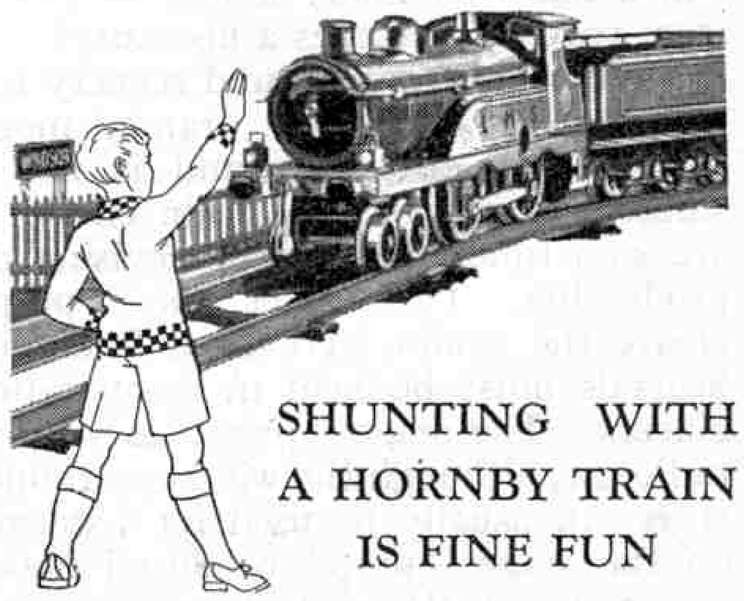
SEND FOR THIS NEW BOOKLET

Every owner of a Hornby Train should have a copy of this splendid new book for it contains much useful information concerning miniature railways. All enthusiasts will find it of great assistance in enabling them to obtain the utmost pleasure and satisfaction from their hobby.

Many very interesting rail formations are illustrated in the booklet and full details of the rails required to construct them are given. As every boy knows, the laying out of a realistic and well-planned track is essential if the maximum amount of fun is to be obtained.

The running of Goods and Passenger Trains in accordance with correct railway practice is dealt with in detail, even to the extent of showing the intricacies of time-table working. Shunting and signalling are also described in an interesting and simple manner.

The price of the booklet is 3d., and if you cannot obtain it at your dealer's it will be sent post free on receipt of 3d. in stamps. All applications should be addressed to Department MA., Meccano Limited, Binns Road, Liverpool.



SHUNTING WITH A HORNBY TRAIN IS FINE FUN

With the Secretary

A Happy New Year!

Once again I have the pleasure of wishing a Happy New Year to all members of the Meccano Guild and to the Meccano Clubs throughout the world. As I stated last month, progress during 1927 has been satisfactory in almost every respect. The total Guild membership has grown steadily, new clubs have come into existence in large numbers and old clubs have increased their strength and extended their activities.

Although the prospects for the coming year are bright, I hope that no member of the Guild will think that it is unnecessary to make further efforts. We all make good resolutions at this time of the year and I should like every Guild member *to resolve that he will recruit at least one new member during the year!*

Although, as I have said, many new clubs have been formed during the past few months, there are still many places where no club exists although there are large numbers of Meccano boys living in the neighbourhood. By neglecting to form themselves into a club these boys are missing a great deal of the best possible fun and I strongly advise them to try the experiment of organising a club in the near future.

Meccano Progress at Cape Town

In last month's notes I referred to the value of a well organised exhibition in attracting attention to the work of a Meccano Club. The importance of this form of publicity is realised very strongly by overseas clubs, most of which make special efforts for their annual functions. A notable example in this respect is provided by the Association of the Peninsula Clubs at Cape Town, South Africa, and I have recently read with very great pleasure a report of their recent exhibition published in the "*Cape Times*."

Under the Leadership of Mr. W. Barrett, the energetic President, the activities of the clubs of the Peninsula have secured for them a very prominent place in the public life of Cape Town. On this occasion their exhibition was opened by His Excellency the Governor-General of South Africa, the Earl of Athlone, who was accompanied by the Mayor of Cape Town, the Speaker of the House of Assembly, and many other influential people.

As was to be expected, the models on exhibition were very striking indeed. Most of them were entries in various contests, and they included aeroplanes, cranes, motor-cycles, ships and trains. A replica of Klipheuvel wireless station and a model showing the relative positions and movements of the Sun, Moon and Earth were also on exhibition, the latter in particular coming in for special praise from Dr. Spencer Jones, His Majesty's Astronomer at Cape Town.

Dr. Spencer Jones has always taken a keen interest in the activities of the Meccano Clubs and in introducing the Earl of Athlone he remarked that the Superintendent-General of Education in South Africa gave special support to the clubs because he realised that Meccano developed the faculty of concentration and demanded in a high degree the co-ordination of hand and brain.

The Earl of Athlone expressed his appreciation of the good work done by Meccano Clubs in general. He felt sure that the principles behind Meccano applied to every age and every walk of life because they sought to form character as well as to instruct and amuse. These principles, he said, were evidently appreciated, as was shown by the existence of the Meccano Guild drawing its members from hundreds of thousands of Meccano boys all over the world.

The following passage in particular from the Earl of Athlone's speech is worthy of reproduction in full and should be read carefully by all Guild members:—

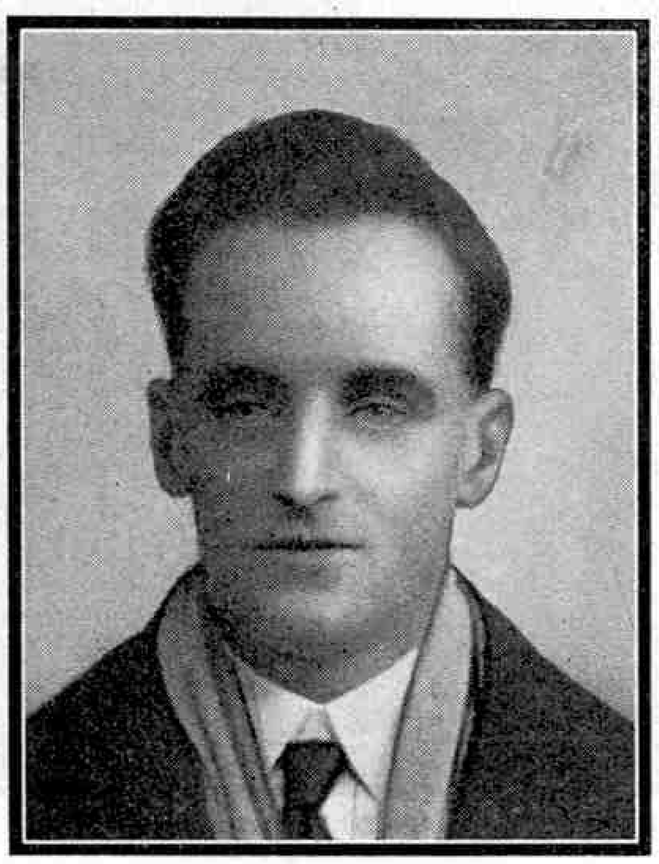
"We all want to acquire habits and qualities that will help ourselves and our fellow men—qualities such as perseverance, accuracy, conscientious method, interest and initiative. These are only some of the qualities that membership of this club helps to develop. Interest, I think, is one of the most important, for men and women who are consistently bored and without enthusiasms are not only a nuisance to themselves but to the world at large.

"No exhibitor who had shown himself capable of the painstaking work, intelligent curiosity, and determination to make good, indicated in the models, would be likely to fail in interest, or perseverance, or conscientious method in any walk of life."

The Governor-General was so impressed with the ingenuity of the Meccano models exhibited that he immediately offered to give a trophy for annual competition in the junior section of the club.

Meccano Club Leaders

No. 33. Mr. J. Pitts



Mr. J. Pitts has been Leader of the Great Baddow Meccano Club since 1924. Under his skilful guidance the club has made excellent progress since it became affiliated and it is largely due to his enthusiasm that the interest of the members has never waned

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places and boys interested should communicate with the promoters, whose names and addresses are given below:—

APPERLEY BRIDGE.—Arnold T. Dobson, Woodhouse Grove School, Apperley Bridge, Nr. Bradford.

BURTON-ON-TRENT.—S. O. Edwards, Hillfields, Holly Street, Stapenhill, Burton-on-Trent.

EGHAM.—H. Honeyball, Raymead, Park Avenue, Thorpe Lee, Egham, Surrey.

FORFARSHIRE.—John Eggo, Scotswood, Northmuir, Kirriemuir, Forfarshire, Scotland.

GALASHIELS.—D. Richmond, 58, St. John Street, Galashiels.

HEBDEN BRIDGE.—H. O. Walker, Knott Hall, Hebden Bridge, Yorks.

HOYLAKE.—H. B. Chrimes, The Leas, Hoylake, Cheshire.

ILKESTON.—J. Bamber, 23, Wharncliffe Road, Ilkeston, Derbyshire.

INDIA (BENARES CITY).—B. N. Ghosh, 121, Ramapura, Benares City, India.

INDIA (BURMA).—Bertie Shaw, Mayfield, Maymyo, Burma, India.

CLUB NOTES

Rotherham M.C.—Unfortunately the club Leader has been obliged to resign but the secretary already has another gentleman in view for the position. Several of the members have left this session but it is hoped to replace them by new members. The secretary will be glad to give details to any intending members. *Secretary*: A. E. Wood, 26, Norfolk Street, Rotherham.

Stoke and Newcastle M.C.—This club is making excellent progress. A model of a Dutch Windmill has been constructed and is exhibited in the shop window of Messrs. Wayte Bros. Hornby Train nights are popular. A definite programme is arranged for each meeting. Club roll: 11. Leader: Mr. W. Wayte, Church Street, Stoke-on-Trent.

Diss Church M.C.—The Winter Session is proving a success and the club now possesses an excellent club room in the Church Hall. The Rector has very kindly offered his services as President and the members are delighted to have his support. New members will be made very welcome. *Secretary*: John J. Maling, 15, Heywood Road, Diss, Norfolk.

Edinburgh Castle M.C.—The club is now in full swing and activities are many and varied. Model-building Competitions are popular and many excellent models are being produced by the members. The club roll is steadily increasing and meetings are held regularly. Club roll: 25. Leader: Mr. Fred R. Winn, 166, The Drive, Ilford.

Memorial (Hull) M.C.—A Recruiting Campaign recently organised proved highly successful and the membership has increased as a result. A recent club night was devoted to steam engines. Several members brought engines along to the club room and exhibited them in working order. Steady progress is reported and the club shows every sign of improvement. Club roll: 15. *Secretary*: Philip Jackson, 68, Westbourne Avenue, Hull.

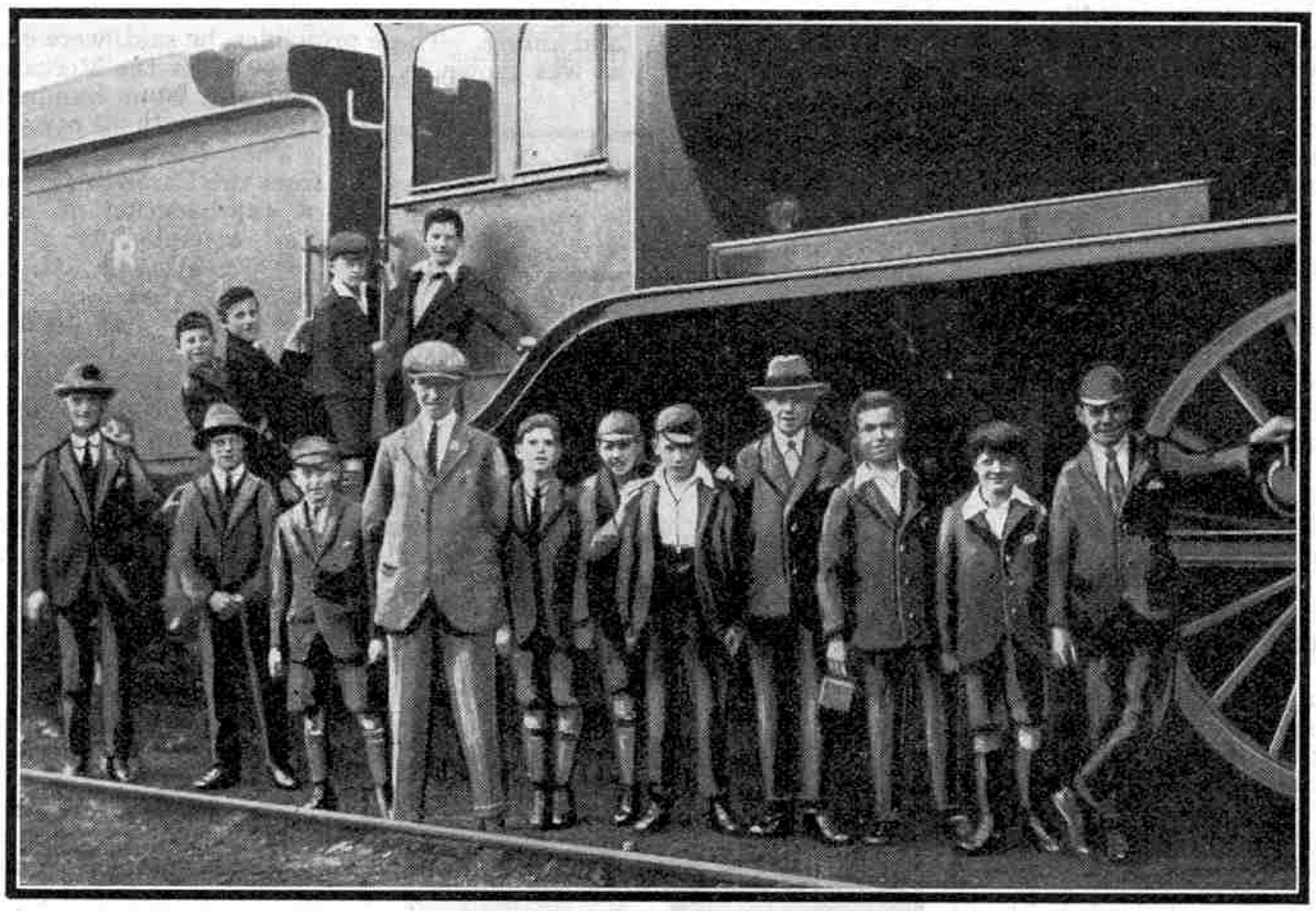
Elm Road (Beckenham) M.C.—A pleasant evening was spent recently with a Meccanograph model loaned from Headquarters with which each member made his own design. An equally successful evening was devoted to a Lecture loaned from Headquarters. A Mystery night proved to be a stamp evening and was quite interesting. The members all seem very keen and a good attendance is maintained. Club roll: 19. *Secretary*: C. W. Price, 52, Queen's Road, Beckenham, Kent.

Holbeach Wesleyan M.C.—Model-building evenings and lantern lectures have proved very attractive, good attendances being recorded. A Motor Chassis model was loaned from Headquarters and the evening devoted to its examination was greatly appreciated by the members, who learned a great deal about the construction of a car from it. The lecture entitled "The Story of the Motor Car" was also obtained from Headquarters and added greatly to the interest of the model. Club roll: 18. *Secretary*: Walter Cook, Hallgate, Holbeach.

Merelands M.C.—The Motor Chassis model was loaned from Headquarters and was exhibited at the local Flower Show where it attracted much attention. At this Show four members of the club won prizes with Meccano models in a competition organised in the Industrial Section. The first prize was won by the youngest member, aged seven, with a realistic model of a Fire Escape. The Leader and members were invited to inspect a Mat and Matting factory in the vicinity and the visit proved most interesting. The month of October was devoted entirely to model-building and many models were constructed. A new feature of the club is stamp collecting and the members are very keen to have really fine collections. Club roll: 8. *Secretary*: Eric Stroud, The Vicarage, Lindsey, Hadleigh.

Annan M.C.—The new session commenced with a prize-giving night, the prizes being distributed by Colonel Irving. After the presentation was over several rounds of boxing were enjoyed by the members. Lantern displays and lectures given by O. Gibbs have been interesting features of recent meetings. Model-building is the chief activity of the members, who have constructed many goods models. Club roll: 22. *Secretary*: W. F. Duff, 10, Hecklegirth, Annan.

Ashby Road M.C.—The club has now settled down to an interesting syllabus and a library containing many interesting books has been formed. A lecture on "Electricity" was delivered by the secretary and was very well received by the members. It is hoped that this will be followed in the near future by a talk on "The Telephone." A concert was recently held at which community singing was indulged in. No charge was made for admission, as this was part of the recruiting scheme of the club. New members are desired and intending members should write to the secretary for full particulars. Club roll: 9. *Secretary*: C. Ward, Millfield Street, Woodville, Burton-on-Trent.



A group of members of the Holy Trinity (Barnsbury) M.C. snapped on a visit to the L.N.E.R. Locomotive Sheds near King's Cross

South Park M.C.—Activities are now in full swing and good progress is reported. Lectures are a popular feature of the syllabus and interesting talks have been given by several of the members. Model-building evenings are frequently held, the members being very keen on this. Two lantern lectures have been included in the programme. Club roll: 29. *Secretary*: D. Bradford, 26, Guildford Road, Seven Kings, Essex.

Eastham M.C.—Competitions are held frequently for model-building, and these attract large entries. The lecture, "Some of the World's Famous Bridges," was loaned from Headquarters and was very much enjoyed. The club night has now been changed to Tuesday instead of Friday as it is more convenient for the members. The Girls' Section continues to make good headway and model-building is very popular with the members. Club roll: 35. *Secretary*: Fred Taylor, Bye-Pass Road, Eastham, Cheshire.

Sittingbourne Baptist M.C.—A Ping-pong tournament in which all the members took part proved quite a novelty, many well contested games being witnessed. The members are hoping to make a ping-pong table very soon. One evening was spent watching paper being made at Lloyds' Paper Mill and the members were very keenly interested in the process. Several model-building competitions have been held. In one of the most successful of these the members were required to build models from a given number of Meccano parts. An assistant Leader has recently been appointed. Club roll: 14. *Secretary*: Donald Thorn, The Anchorage, Addington Road, Sittingbourne.

Castle Douglas M.C.—Meetings are well attended, and the members are very enthusiastic. A surprise party recently held proved very enjoyable. The members are keen model-builders, and the Leader reports that many excellent models are built by them. Leader: Mr. Peter Thomson, 106, Queen's Street, Castle Douglas.

Winchmore Hill Collegiate M.C.—Unfortunately, meetings have had to be suspended for a short time owing to the fact that a suitable club room could not be secured. However, the difficulty has now been solved, and it is hoped that everything will run quite smoothly in the future. A new Committee has been elected, and the Railway Section brought into order by the appointment of a secretary. The Stamp Section is making good progress. Club roll: 29. *Secretary*: K. Walden, 18, Old Park Road, Palmers Green, London, N.13.

Withington M.C.—The syllabus includes Model-building, Lantern Lectures, Talks, etc., and is proving very interesting. At the last stamp evening the members' parents were invited and this evening proved quite a success. A Lantern lecture kindly loaned by Messrs. Cadbury Bros. entitled "A Visit to Bournville Works," provided a most enjoyable evening. At a recent club night novelties were brought by the boys and some very interesting things were displayed. Club roll: 12. *Secretary*: K. Cradduck, 36, Mauldeth Road, West, Withington, Manchester.

South Dublin M.C.—This club has recently been affiliated and is making excellent progress. A good programme has been drawn up and includes model-building, Wireless Evenings, Lectures, Debates, and many other interesting subjects. Radio Evenings are very popular as the members are specially interested in the hobby. Club roll: 10. *Secretary*: Garratt M. Foley, 44, Eaton Square, Terenure, Dublin.

Stonefield Parish Church (Blantyre) M.C.—Is making excellent progress and model-building is a prominent feature of the syllabus. Models of the Forth Bridge and the Horizontal Steam engine are being built. There is plenty of room for more members and those wishing to join should write to the secretary for full particulars. Club roll: 12. *Secretary*: Tom Kerr, 2, Hardie Street, Blantyre.

Selkirk M.C.—Club meetings are made very interesting and Model-building and Hornby Nights are popular. A novel device introduced for use on Hornby Nights is a telephone connected from one room to another, whereby advice of the despatch of the trains is given. Many interesting papers have been given and these include one entitled "How to fit up an electric light." A club Exhibition was arranged to take place in December, and plans to make it an outstanding success were entered into with enthusiasm. Club roll: 17. *Secretary*: Walter Blake, 76, Scott Crescent, Selkirk.

Victoria (Glasgow) M.C.—A party of boys recently visited the Liner *S.S. Cameronia*, and greatly enjoyed being shown round. The club has been divided into sections and the scheme is proving quite a success. An interesting demonstration of levers was given recently by the secretary. "A trip through the Scottish Borderlands and Galloway" was the subject of a lecture delivered recently and slides for which were loaned by the L.M.S. Railway Company. The lantern was operated by Mr. Clarke, an old friend of the club. Unfortunately the club is still without a Leader and any gentleman who is willing to help in this capacity is asked to communicate with the secretary. Club roll: 38. *Secretary*: Henry C. Thompson, 4, Montgomerie Gardens, Scotstoun, Glasgow.

Albert Village M.C.—The membership of the club unfortunately shows a decrease but it is hoped to organise a Recruiting Campaign very soon. A Concert was recently held and proved quite successful. The chair was taken by the Leader and various songs were given. The play "Nonsense Nana" also figured in the programme and was well appreciated. A domino handicap was held and was won by H. Eames. The Hornby Section which has been formed is proving quite successful and a train layout has been procured. Plans are on foot for an Exhibition which it is hoped will be a great success. Several of the members united to form a stall at the Chapel Bazaar and this realised £10. Club roll: 20. *Secretary*: L. S. Adey, 239, Occupation Rd., Woodville, Nr. Burton-on-Trent.

Plymouth M.C.—Good progress is reported, Lectures and model-building being the main features of the programme. A model-building competition has been planned and the boys are quite keen about it. It has been proposed to start a Girls' Section and a Football Section is also under consideration. One member brought a model of Major Segrave's car of his own construction and this proved very fascinating to the younger members. Club roll: 40. *Secretary*: Kenneth Wills, 8, Beechwood Avenue, Mutley, Plymouth.

Australia

Swastika (Australia) M.C.—Meetings are well attended and an interesting programme is being followed. Several excellent papers have been read and a Library has been started. The Rev. J. French very kindly gave a talk on his travels in Europe, which was well received. Several models are to be displayed in a local shop window. Table Tennis is popular and frequently appears on the programme, and a Mock Trial has also been organised. The second Exhibition has been held and proved a great success. Club roll: 18. *Secretary*: Ronald Wood, 26, Jeffery Street, Solomontown, S. Australia.

Singapore

Singapore Chinese M.C.—This club was recently affiliated with the Guild and appears to be making excellent progress. Sports are to be a popular feature of the syllabus and will include Swimming, Badminton, Football, and Running. It has been decided to hold fortnightly meetings as this is more convenient for most of the members. The Leader is hoping to enrol many new members in the near future and intending new members should apply to him for full details. Club roll: 35. Leader: Mr. Choo Teck Hong, 57, Joo Chiat Terrace, Singapore.

Egypt

Cleopatra (Cairo) M.C.—The School holidays have finished and the members are now all back in Cairo. Arrangements for the Autumn Session are complete. In a Competition that has been arranged, every member is to write a short essay entitled "How I Spent My Holiday this Summer." Several prizes are to be given and the idea is proving very attractive. Club roll: 33. *Secretary*: Abd El Hamid Amin, 2, Haret El Ismaily, Nasria, Cairo, Egypt.

New Zealand

Dunedin M.C.—A lecture on "Sailing Ships" was recently given by Mr. H. Cole. The lecturer offered a prize for the best drawing of a full rigged ship, and the members are eagerly awaiting publication of the results. Clay modelling is an interesting feature of the syllabus. Competitions are frequently held and Stamp Night is popular. Club roll: 24. *Secretary:* Tony MacLachlan, Art Studio, 66, Albany Street, Dunedin, New Zealand.

Clubs Not Yet Affiliated

Froyle (Hampshire) M.C.—A club has been started in Froyle and appears to be making excellent headway. There is room for more members, however, and intending members should communicate with Mr. W B. Snelling, whose address is given below. Several attractive sections are to be formed and an interesting programme has been arranged. Leader: Mr. W. B. Snelling, Brewery House, Froyle, Hampshire.

Haileybury (Canada) M.C.—More new members are urgently required for this newly formed club. Those wishing to join should write to the secretary, who can assure them of a hearty welcome. A Leader has not yet been secured, but it is hoped that one will be found in the near future. *Secretary*: Edward Hincks, Haileybury, Ontario, Canada.

West Hartlepool M.C.—The secretary has been successful in securing a suitable club room and meetings are held every night at 6.45. New members will be made very welcome. Affiliation is to be applied for very soon. *Secretary*: E. W. Dickinson, 71, Arncliffe Gardens, West Hartlepool.

A Brotherhood of Boys

Why You Should Join the Meccano Guild

The really happy boys throughout the world to-day are those who have a hobby in which they take an enthusiastic and lasting interest, and the happiest of all are Meccano boys, for their's is the greatest of all hobbies. When a boy takes up a hobby, whatever it may be, he feels a great desire to meet other boys having interests similar to his own, and to compare notes and talk things over with them. This is particularly the case with Meccano. No Meccano boy is content to "play a lone hand" for long. He very soon wants to meet other Meccano boys, to see their models and to show them his own, and to discuss plans and schemes for other and bigger models.

How the Guild Began

It is more than 20 years since Meccano began to take its place as the greatest of all hobbies, and even in those early days Meccano boys were forming themselves into little clubs and societies. These organisations steadily increased in strength and numbers but by degrees they began to realise that they were suffering from a very serious defect—they were isolated, each doing good work in its own little sphere, but knowing nothing of what other similar organisations were doing.

Presently we at Meccano Headquarters began to receive letters asking us to set up some form of central organisation to which all the individual clubs and societies might look for guidance and which would weld them all into one great body. Day by day these letters increased in number, and we realised that the desire for a central organisation was genuine and widespread. We were only too willing to do all that we could in the matter but, realising the immense responsibility and the enormous amount of work involved in taking such a step, we delayed action until we felt that we had the means and facilities for carrying out the task successfully. By 1919 we felt that we were in a position to tackle the job and in that year the Meccano Guild came into existence.

It is important to remember that the idea of a Guild did not originate at Meccano Headquarters. The Meccano Guild was organised solely as the result of urgent representations from boys all over the world. They, as Meccano boys, felt the need of attaining unity by means of such an organisation and we at Headquarters felt it our duty to do everything we could to satisfy the demand.

A Unique Brotherhood

So the Meccano Guild, the most remarkable brotherhood of boys in the world, came into being in the year 1919, with Mr. Frank Hornby, the inventor of Meccano, as its president. The announcement of its birth was received with the utmost enthusiasm throughout the great army of Meccano boys of all nations, and applications for membership began to come in immediately in large numbers. Since that time the membership of the Guild has grown enormously, and a special feature of its growth has been its steadiness, year in and year out.

Objects of the Guild

The three objects of the Guild, set forth in the form of application for membership, are as follows:—

(1) To make every boy's life brighter and happier.

(2) To foster clean-mindedness, truthfulness, ambition and initiative in boys.

(3) To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.

In order to join the Meccano Guild it is necessary for the form of application to be filled up, signed and witnessed. This form is then sent to the Secretary with a remittance to pay for a badge. The applicant is then duly enrolled as a member of the Guild and his badge and membership certificate are sent to him. The neat little triangular badge—its three corners representing the three objects of the Guild—and the handsome certificate are always received with enthusiasm. Most members have their certificates framed and hung in their own rooms, where they can always see them. The price of the Guild badge is 7d., or 1/– if sent overseas.

The Correspondence Club

Although the Guild was originated for the benefit of Meccano Clubs it includes to-day a very large number of "lone" members. In many cases these members live far away from a Mecano Club and sometimes far away from any other Meccano boy. It is a great joy to such members to have someone to write to who is really interested in the Meccano hobby, and it was the realisation of this fact that led to the inauguration of a Guild Correspondence Club. Through the medium of the Correspondence Club boys living in the remotest parts of the world are placed in touch with other boys of their own age and of similar interests. In most cases correspondence is carried on regularly, and results in the formation of firm friendships, although the boys may be living hundreds or even thousands of miles apart. Boys who have become acquainted through the Correspondence Club have even visited one another, each spending a happy holiday as a welcome guest in the home of the other.

The "*Meccano Magazine*" is the official organ of the Guild, and each month two or three pages are devoted to Guild matters. The progress of the various clubs all over the world is reported briefly and photographs are published of Leaders, and secretaries and club groups. Thus, by means of the "*Meccano Magazine*," each club is kept acquainted with the progress of all other clubs.

Every Meccano boy should be a member of the Guild. As soon as he receives his badge and certificate of membership he has the right of entry into the innermost circles of Meccanoland. His pleasure in his hobby is increased enormously and he has the keen satisfaction of knowing that, instead of being an isolated unit, he belongs to a great brotherhood of boys with members in every country in the world.

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85	,,	...	1/8	215	,,	...	9/6
95	,,	...	2/–	225	,,	...	10/6
105	,,	...	2/4	235	,,	...	11/6
115	,,	...	2/8	245	,,	...	12/6
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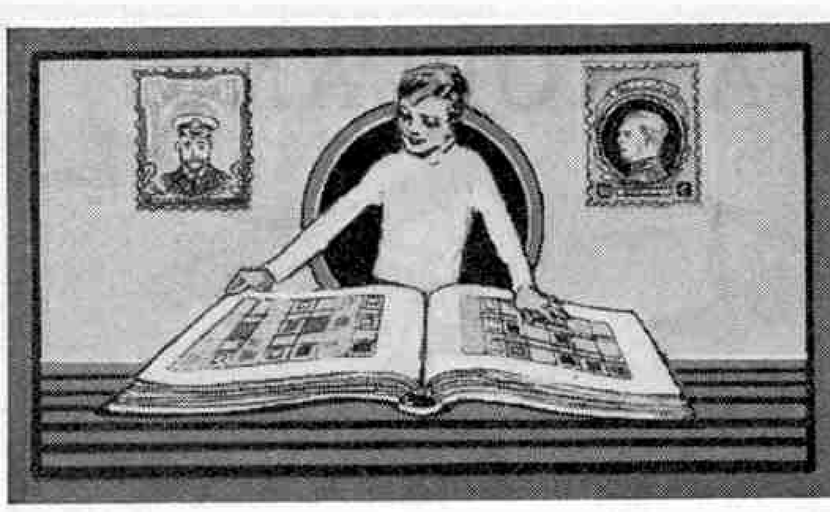
Stamp Advertisements continued on page 96



Stamp Collecting

THE EARLY DAYS OF THE STAMP COLLECTOR

AT this season of the year many of our readers will be rejoicing in the possession of a brand new stamp album and a firm resolution that in future stamp collecting is to be *the* hobby. A few words of advice on the formation and building up of a collection doubtless will prove of help to the new collectors and also of interest to those who have passed through the novitiate stage.

The 10 Kopeck stamp of the 1919 Batum (British Occupation) issue. This stamp was issued unwatermarked and imperforate

First of all it must be emphasised that the possession of an album with thousands of blank spaces waiting to be filled, and a packet of assorted stamps, does not constitute a stamp collector in the true sense. The collector who would secure the greatest possible amount of enjoyment from his hobby must aspire to greater heights than the casual filling of the blank pages of his album. Simple love of acquisition, although it is admittedly the base on which all forms of collecting are founded, is not the end but only the means to the end. The true joy of stamp collecting lies in the study of the great variety of sources from which the stamp designs are drawn.

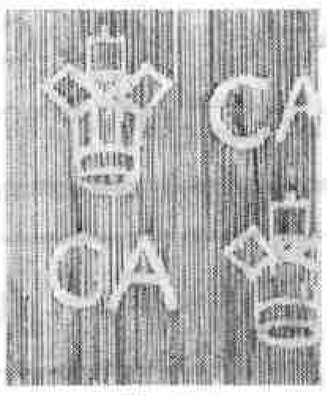


Fig. 1

Assuming the possession of an album and a packet of stamps, we come immediately to the important question of mounting. For this purpose there will be required a number of stamp mounts or hinges, and here the reader is strongly advised not to make the mistake of buying the cheapest. He should insist upon "peelable" hinges. Sometimes it becomes necessary to remove the hinge from the back of a stamp and with these hinges the operation may be performed without causing any damage to the stamp. This is a point of great importance because a damaged stamp is worthless.

The next necessity is a catalogue. Many young collectors appear to regard this item as of little importance, but as a matter of fact a very large proportion of the fun in stamp collecting is lost in the absence of a catalogue. It is indeed no exaggeration to say that a catalogue to the stamp collector is as important as the compass is to the mariner. First of all it enables him to identify his stamps with certainty and to decide the order of their appearance in the album. In addition, it quotes the market value of every stamp issued, so that the collector can estimate the growing value of his collection as it increases in numbers and quality. A good catalogue also draws attention to the many distinctive features that stamps possess in addition to the design. To casual observers many stamps are precisely identical, but to the collector who knows something of watermarks and perforations many wonderfully interesting differences are revealed.

The 2c Trans-Mississippi Exhibition Commemorative stamp. Issued in 1898. No watermark. Perforated 12 all round

The 2½ grouch Turkish issue of 1926. The view represents the famous Gorge of Sakaria. Like the remaining stamps illustrated on this page, it is unwatermarked. Perforation, 12 all round

The watermark is a device in the form of letters, figures, or some simple design, made in the actual paper on which the stamp is printed. Its object is to prevent forgery, but as regards the collector its main value lies in the fact that it classifies stamps of similar design into individual groups. For example, the majority of British stamps of the George V issues prior to 1921 were watermarked "Multiple Crown CA" (see Fig. 1). In 1921 the "Multiple Script CA" was introduced (Fig. 2). The face designs of the stamps remained unaltered, but nevertheless the "Multiple Crown CA" variety automatically became obsolete.

Watermarks usually are easily discernible on account of their transparency, particularly if the stamp is placed on a polished black surface known as a watermark detector. In extreme cases a small quantity of benzine should be dropped on to the stamp and the watermark then will stand out clearly. The benzine does not harm the stamp; on the contrary many a dirty stamp has emerged from its benzine bath looking decidedly fresher and more youthful!

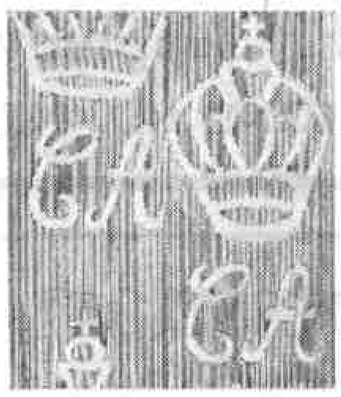


Fig. 2

The 60c Italian Royal Jubilee issue of 1925. It was issued with two standard varieties of perforation (a) 14 all round and (b) 11 all round. It was unwatermarked

As most of our readers know, the earliest postage stamps were used in such a form that single copies had to be cut with scissors from sheets before use. Obviously this method of issuing stamps was a great time-waster and it was not long before some system of easy separation was demanded. The two principal systems in use to-day are "perforation" and "rouletting."

The perforation is the row of tiny holes separating each stamp from its neighbour. For the collector's purpose perforation is measured by the number of holes that occur in a space of 20 millimetres. When the perforation of the top and the bottom differs from that of the sides, the measurement of the top and the bottom is given first and then that of the sides—for example, $13 \times 13\frac{1}{2}$. A perforation gauge is indispensable to the stamp collector, and in order to assist readers the Editor has had prepared a simple gauge which can be obtained from the "*M.M.*" office for 1d. post free.

Rouletting consists merely of nicking or cutting the stamp margins, without actually removing any paper, in such a manner that individual stamps may be torn apart quite easily. Greece is one of the few remaining countries that still roulettes its stamps.

It would be possible to continue almost indefinitely without exhausting the range of technical expressions used in stamp collecting, but those we have just explained will cover the immediate problems with which the beginner is faced. In a very short time the young collector will find himself almost imperceptibly becoming familiar with the remaining technical terms and after a few months' experience he will be quite at home with the language of his hobby. Difficulties are bound to crop up occasionally, however, and in such cases the Editor is always ready to assist and advise his stamp-collecting readers.

The 5c John Ericcson Commemorative, issued by the U.S.A. in 1926. It was unwatermarked. Perforation, 11 all round

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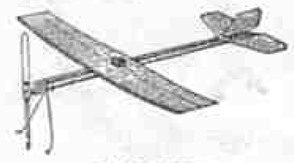

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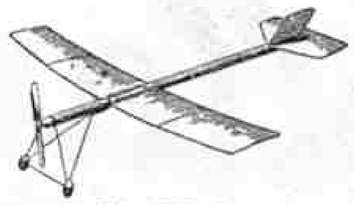

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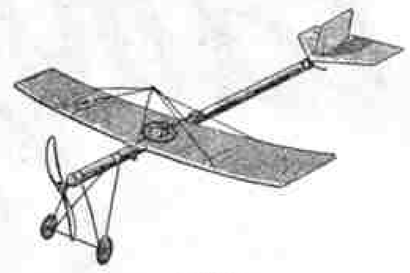

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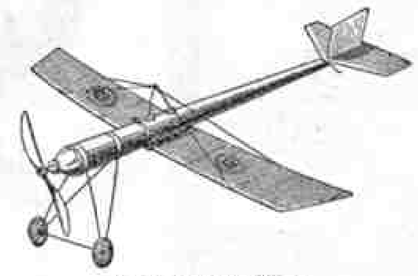

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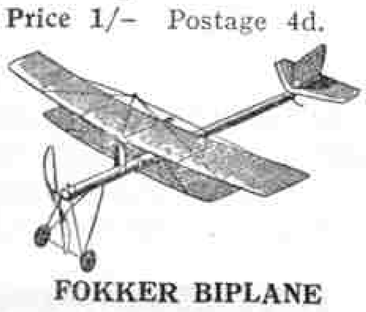

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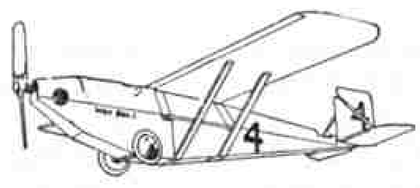

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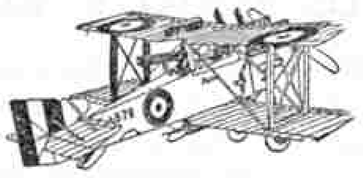

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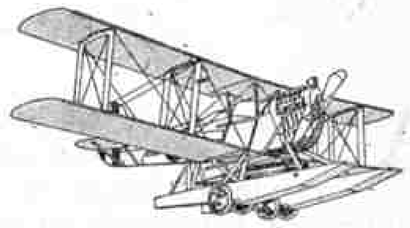

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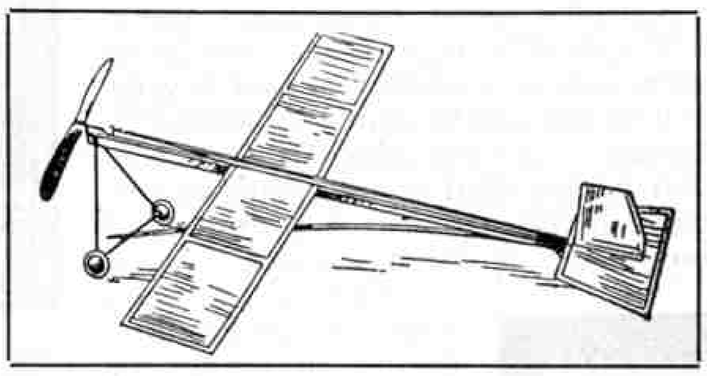

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January Puzzles

As the result of an insistent demand from many hundreds of readers, the Puzzles Page is re-introduced again.

In one feature, at least, this month's page differs from those of previous years; no prizes are offered for correct solutions. It is impossible to give here all the reasons for this departure but, briefly stated, it has been found impossible to reconcile the interests of both overseas and home competitors and still publish the solutions one month after the original puzzles. The withdrawal of prize awards affects only a few; the withholding of the solutions until the closure of the overseas section affects thousands.

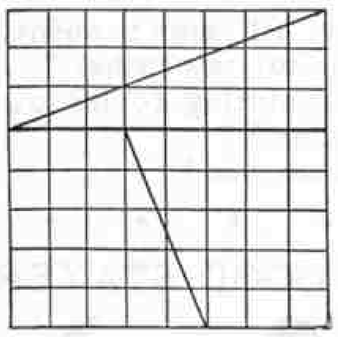
The solutions to the puzzles given below will appear next month and in the meantime a test for sharp wits is provided.

Puzzle No. 1. *Contributed by H. Rumbold, Reading.*

My first is in teaching, but cannot be learnt,
My second is in flame and cannot be burnt.
My third is in burden, but not in load,
My fourth is in frog, but not in toad.
My fifth is in case, but not in box.
My sixth is in wolf, but not in fox.
My whole is a highly intelligent people,
Religious, but rarely found under a steeple.

* * * *

Puzzle No. 2.



The square in the diagram above is divided into 64 smaller squares. By cutting it into four pieces, as shown, and re-arranging the square to form a rectangle 13 squares in length and five in width, it will be found that the rectangle now contains 65 small squares. Where has the extra square come from?

* * * *

Puzzle No. 3. *Contributed by F. Kendall, Wakefield.*

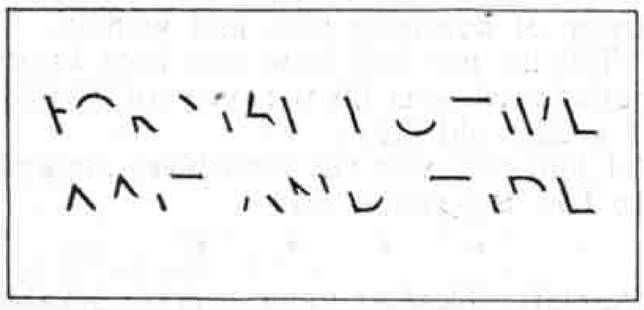
Johnny had been a very naughty boy and for punishment his mother locked him in a store cupboard. The punishment really was not as severe as his mother thought, for Johnny saw many interesting things and passed quite a happy time. The names of the articles and foodstuffs that he saw are hidden in the following sentences.

"There was a singular darkness, not easily dispelled, but terribly swift in kindling terror by its sombre advance and its altitude."

"A little bee from its hive was shut up, enclosed in a box, and it was nearly destroyed by the new axe sticking up in so dangerous a way."

"If I should go on with my music and lessons, I would do so, but to negotiate with my master I met him at Chester, where we had much amusement."

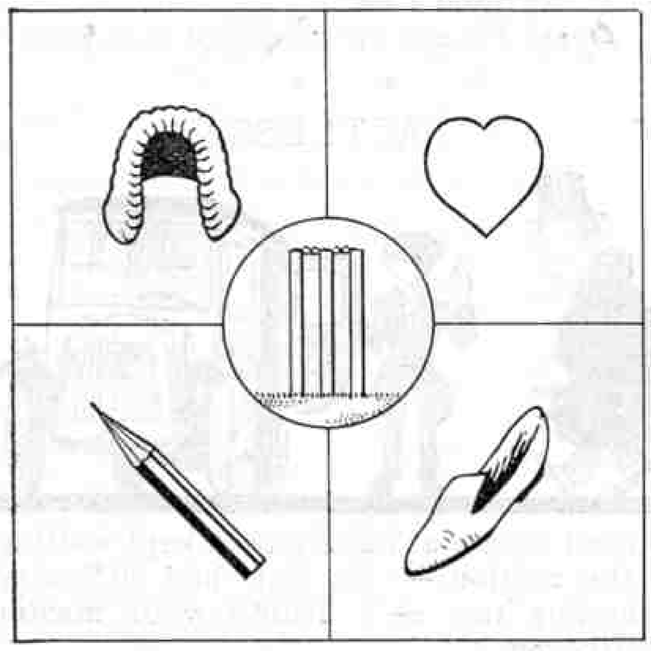
Puzzle No. 4. *Contributed by P. Sutcliffe.*



In the two lines of broken type shown above a well-known proverb is hidden. The letters of each word are in correct order, but the words are jumbled.

* * * *

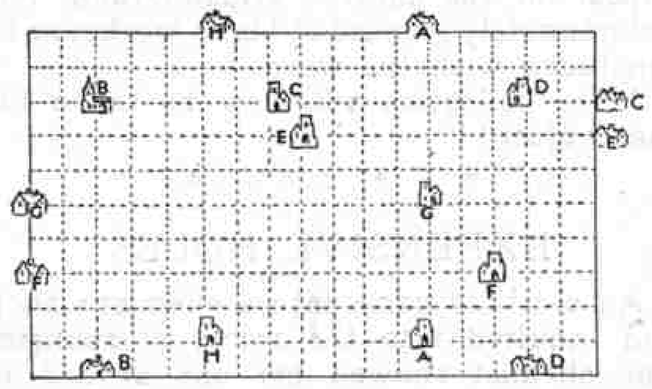
Puzzle No. 5. *Contributed by P. Sutcliffe.*



The name of a famous city is hidden in the above set of pictures. It will be revealed by taking two consecutive letters from each name and re-arranging them. What is the city?

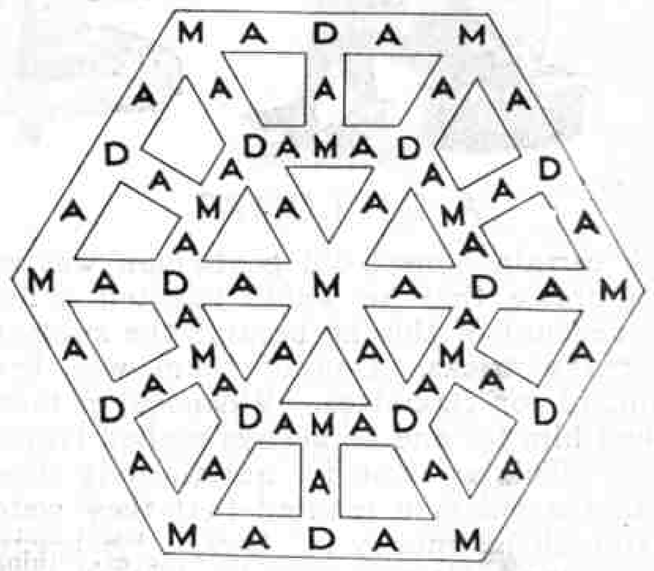
* * * *

Puzzle No. 6. *Contributed by S. E. Lake.*



A certain famous American town possesses eight churches and one Sunday eight motorists set out from home, each to drive to one of the churches. In the diagram above are shown the location of their respective homes, the churches they were to attend, and the available roads. The roads appear as dotted lines. Thus A had to get to A, B to B, and so on. But it was a condition of their journeys that no motorist crossed a track made by another motorist. Trace their individual routes.

Puzzle No. 7.



In how many different directions is the word "Madam" printed in the above diagram?

* * * *

Puzzle No. 8. *Contributed by G. Higgins, Alderley Edge, Cheshire.*

Harry's sleeve had rubbed against his slate as he was going to school and many of the figures in his long division sum had become erased. Inserting an X to represent a place where a figure had been rubbed out, the sum was like this:

```
215)X7X9X(1XX
     XXX
     ---
     X5X9
     X5X5
     ----
      X4X
      XXX
      ---
```

He remembered the sum was perfectly divisible and being a smart lad he was able to complete it correctly. How did he do it?

* * * *

Puzzle No. 9. *Contributed by R. G. Webster, Wormit.*

H	T	U	O	M	P	E	E
H	U	L	L	S	O	N	D
S	A	L	G	T	R	U	D
G	O	C	K	B	L	I	N
H	W	I	W	U	N	O	L
A	L	H	A	D	D	E	N
F	I	K	C	N	O	E	D
A	X	W	I	A	B	E	R

In the above word square a number of well-known towns in the British Isles are hidden. What are they? The letters of each town follow in perfect sequence as moves are made from square to square. The moves may be horizontal, vertical, or diagonal.

Fireside Fun

A DIPLOMAT

A certain honest old gentleman was so honourable that he would not tell a lie. On account of this he became the subject of many tricks. One of them was the demand for cigarettes. Whenever a man asked him for one he always replied truthfully. This went on for quite a long time until the old man realised that they were taking all his money in ' fags.' He began to ponder a bit and then he decided that he would have two cigarette cases. He would call one World and the other Providence. One day one of his comrades came up to him.

" Got a cigarette ? " he asked.

" I haven't one in the world," replied the old gentleman.

" Well, what are you going to do ? " was the immediate rejoinder.

" Oh, I'll trust to Providence," came back the reply.

* * * *

A small boy visited the library regularly, but strange to relate he always had the same book. One day the librarian, curious to know the reason for the lad's devotion to the book, looked over his shoulder. When the boy came to a picture of a bull chasing a farmer, he gave one sigh and said : " I wonder when he will catch him ! "

* * * *

" MOTHICAL "

" If it's an all wool vest why is it marked ' cotton ' ? "

" Well, sir, that's just to deceive the moths ! "

* * * *

Two darkies were reading the inscriptions on tombstones in a cemetery. One of them let out a loud " Haw ! haw ! " and when the other came to the tombstone he pointed to the inscription, which read : " Not dead, but sleeping."

" Haw ! haw ! " laughed the darkie ; " he ain't fooling nobody but hisself ! "

WHY HE DID IT

Because he had crawled out on thin ice and rescued a playmate who had fallen through, little Willie was the centre of a group of admiring men and women.

" Tell us, my boy, how you were brave enough to risk your life to save your friend," said a dear old lady.

" I had to," was the breathless answer. " He had my skates on ! "

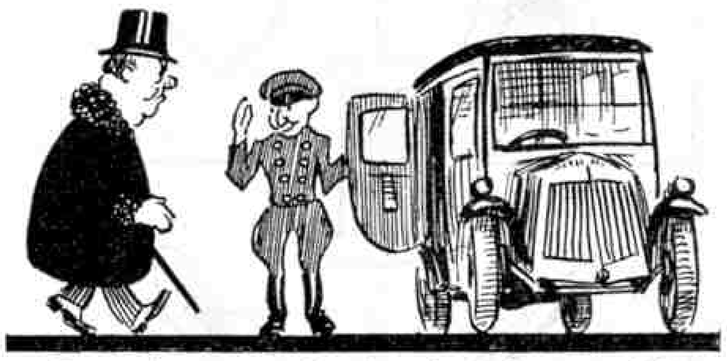
* * * *

(Axolotl : Mexican name. A remarkable example of the tailed amphibian found in Mexican lakes, possessing four limbs resembling those of a frog, and retaining throughout life both lungs and gills).

There once was a young Axolotl
Who said to himself, " Wonder whotl
Happen to me
If captured I be :
Guess I'll eat out my Soul in a Botl."

* * * *

TACTLESS



Guest (angry at having been kept waiting at the station)—" So you had difficulty in finding me, eh ? Didn't your master describe me ? "

Chauffeur : " Yes, sir ; but there are so many stout gentlemen with red noses ! "

* * * *

A vicar had for his curate a tall, cadaverous-looking individual. One Sunday, according to custom, the vicar made an appeal for the curate's stipend fund, but unfortunately glanced at his co-worker as he concluded with the words :—

" The collection will now be taken for that object ! "

* * * *

EXPENSIVE HOLES

An old lady came into a chemist's shop and inquired into the prices of sponges. The chemist showed her one at 3/3 to which she remarked, " Goodness, ain't they dear and all them 'oles in 'em ! "

* * * *

The maid was leaving, and her mistress said to her, " Mary, I should like to give you a good reference, but my conscience compels me to state that you never got the meals ready at the proper time. Now, I wonder how I can put it in a nice way ? "

" Well, ma'am," said Mary, " you can say I got the meals the same as I got my pay."

A BIT " MICXED "

A young man, having joined the Army, was often chaffed by his companions about an impediment of speech with which he was afflicted. This joking he took in good part, with the exception of that from the sergeant, who usually addressed him by his number, which was 666. Speaking to him one day, he said : " Private Thompson, what is your number ? "

Private Thompson replied : " Half a dozen, half a dozen, half a dozen, you fool. You thought I would say, thicx, thicx, thicx, didn't you ? But I didn't ! "

* * * *

Jessie had been sent to a fashionable boarding school, and after the first two weeks she signed her letters home " Jessica."

Presently she received a letter from her father, a plain but prosperous farmer. He wrote :—

" Dear Jessica,—I received your welcome letter. Mamaica and Tomica are quite well. Tomica has a new friend named Samica Jonesica. Aunt Maryica and Uncle Georgeica have gone to London.—Your loving Dadica."

* * * *

Small Shopkeeper : " 'Ere, you ! I don't like the ring of this florin ! "

Shady Customer : " What do you expect for two bob ? A peal of bells ? "

* * * *

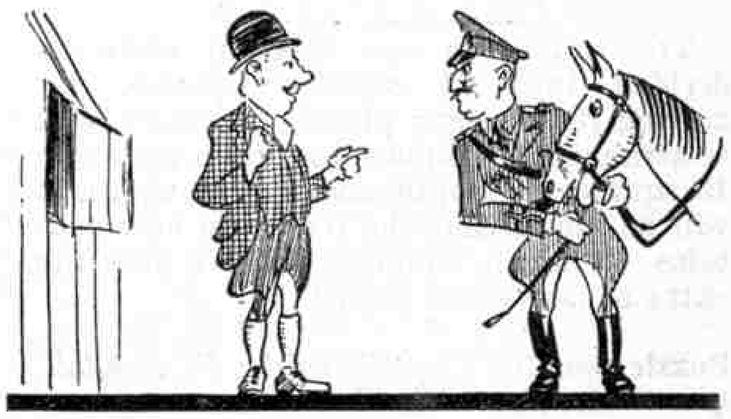
Small Boy (in men's outfitters) : " I want a collar for my father."

Assistant (pointing to his own collar) : " One like mine ? "

" No, a clean one ! "

* * * *

A GOOD STAYER



A cavalry officer desired a hunter, but, being unable to afford anything like a thoroughbred was forced to purchase a very ordinary hack of doubtful ancestry. " I assure you, sir, 'e's a good 'oss, bred in military traditions," said the dealer, and so the bargain was struck. The animal, however, proved to be terribly slow so the officer in a rage returned to the dealer.

" I thought you said that brute was bred in the military tradition ? " he shouted.

" That's right, boss," grinned the dealer, " 'e'd rather die than run."—" *Liverpool Post.*"

SOME SWALLOW

Some boys were being given instruction in diving. The particular lesson was a swallow dive.

" Now, Brown," said the teacher to the most backward pupil, " you take a turn."

Brown made a hopeless attempt and created an alarming splash.

" That is not a swallow dive," said the teacher.

" Isn't it ? " gurgled the unfortunate Brown. " Why, I thought I'd swallowed the whole pond ! "

* * * *

Asked to write a sentence containing the word " Hankow," Tommy wrote : " There is a firm in China called Messrs. Jones Hankow."

* * * *

The plumber and his mate were carrying out a job for a university professor. At one point their instructions read :—

" At a point so situated on the surface of the material as to be equidistant from the extreme edge in all directions, produce by means of a suitable cutting device of correct form and dimensions, a circular aperture, having a uniform diameter of .5 inches."

" Blow me, Bill, what's all that abaht ? "

" Why, yer igneramus, shove a 'arf-inch drill through the middle."

* *

Tommy (preparing home lessons) : " Father, is whisky-and-soda joined together with a - ? "

Father (absently) : " Siphon, my boy."

* * * *

A son of Erin once described his first day's shooting in the following way :— " The first bird I ever shot was a squirrel, and the first time I hit him I missed him altogether. The next time I hit him I hit him in the same place. After that I took a stone and dropped him from the tree, and he fell into the water and was drowned. That was the first time I ever shot one ! "

* * * *

HOW MUCH !

The inquisitive traveller saw an Irishman on the river bank and watched him hauling water up. " How long have you done this ? " enquired the inquisitive one.

" Tin years, sor."

" And how many bucket-fulls do you carry off in a day ? "

" Tin to fifteen, sor."

" Dear ! Dear ! Now how much water would you say you had carried since you started ? "

" All the water you don't see there now, sor ! "

NOT A MECCANO BOY !

Son (aged 6) : " Daddy ! "

Father : " Yes, my son, what is it ? "

Son : " I know what I'm going to be when I'm a man."

Father : " Fine, what is it ? "

Son : " A Sunday School teacher."

Father : " Why ? "

Son : " 'Cause you only have to work one day a week ! "

* * * *

Jack put a stick of dynamite
Inside the stove to heat,
And when he went to bed that night
His sleep was calm and sweet.
Some of him slept upon the hill
And some upon the dale,
And some beside the little brook
That ripples through the vale.

DIPLOMATIC

The other day a boy ran into a butcher's shop and asked for half a pound of tough steak.

" You mean tender, don't you ? " said the butcher.

" No, tough."

" You must be a funny lad, or you have made a mistake."

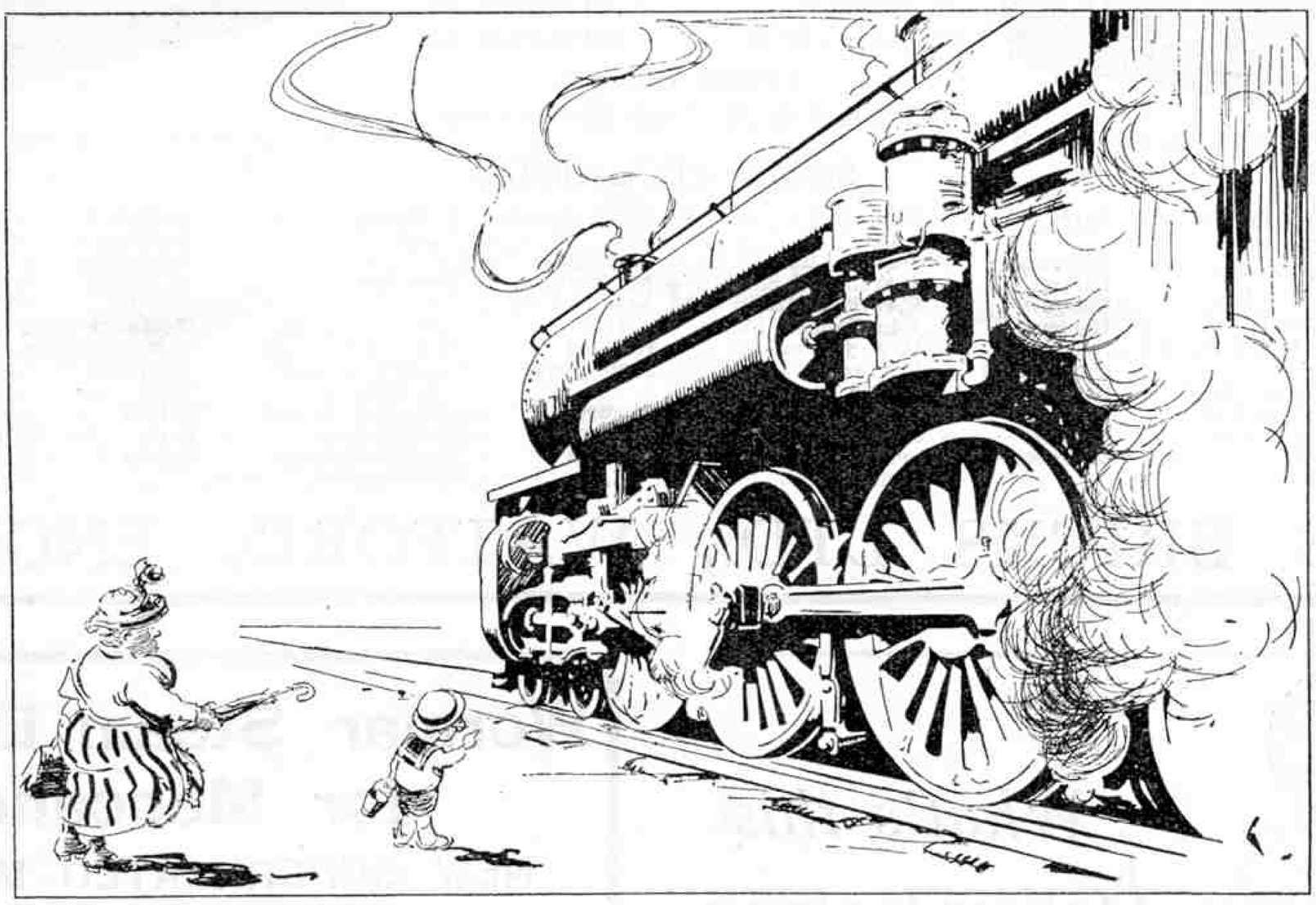
" No, it ain't any mistake. It's for father's supper, see, and if it's tender he'll eat it all, but if it's tough I'll get a bit."

* * * *

Visitor (discussing batsman who has badly mistimed new bowler's first ball) : " He was very late for that first delivery."

Native : " 'E allus is. 'E's our milkman ! "

* * * *



" 'Ere, Willie, come away from that there engine, you know you'll only go and break something "

Frith's " Town Topics." (Melbourne)

" Do you believe in prophecy ? " Pat asked Mike one day.

" I do, indade," was the reply. " There was my old friend O'Hara. Everybody said he was a broth of a boy. Well, now, him and me went out with an expedition into the middle of Africa two years ago, and while we was there we fell into the hands of cannibals. I escaped, but O'Hara got nabbed, and they made stew of him. How's that for prophecy ! "

* * * *

JES' SO

Teacher : " Give me a sentence with the word ' avaunt ' in it."

Little Abie : " Avaunt vat avaunt ven avaunt it."

* * * *

" I'm giving money away ! " shouted Swindler Sam. " Who'll have eight'n pence for a bob ? " Up jumped Jimmy Sharp, " Here, I will." The shilling was handed over and Jimmy received some coppers in exchange. But this apparently did not satisfy, for he exclaimed, " Hi ! You've only given me eightpence for my bob ! " " Well," said the swindler, " that's what I said—eight in pence. See ? Not bad, eh ? " " No," retorted Jimmy, " but the shilling was ! "

A discussion arose in a railway compartment concerning ants.

" Oh " said a former colonel, " When I was out west the ants were as big as my fist and slaughtered one another and dug up the ground with their large horns."

" That's nothing," said a gloomy fellow in the corner, " the ants in the east can beat that. They can carry loads weighing tons, can kill a man with one blow and can knock down trees. I have seen them do so."

" Pray," said the colonel frigidly, " what kind of ants are those ? "

" Eleph-ants," said the other calmly.

* * * *

Needing advice an old country woman wrote the following letter to the Board of Agriculture : " Every morning I find two or three of my chickens lying on the ground cold and stiff with their feet pointing skywards. Please tell me what is the matter ? "

In due course she received a reply, which ran : " Dear Madam, your chickens are dead."

* * * *

NOT DRESSED FOR THE PART

Gordon, seven years old, was playing bandit, and for some time had been staggering around as if badly wounded, without actually toppling over as a victim of the imaginary bullets of his playmates.

A neighbour watching the game called to him : " Gordon, why don't you fall down ? "

" I can't," answered the boy crossly : " I'm not allowed to. If I had on my old pants I'd have been dead long ago ! "

* * * *

Sarcastic Foreman to lazy Workman : " You look about as busy as a sun-dial in a fog ! "

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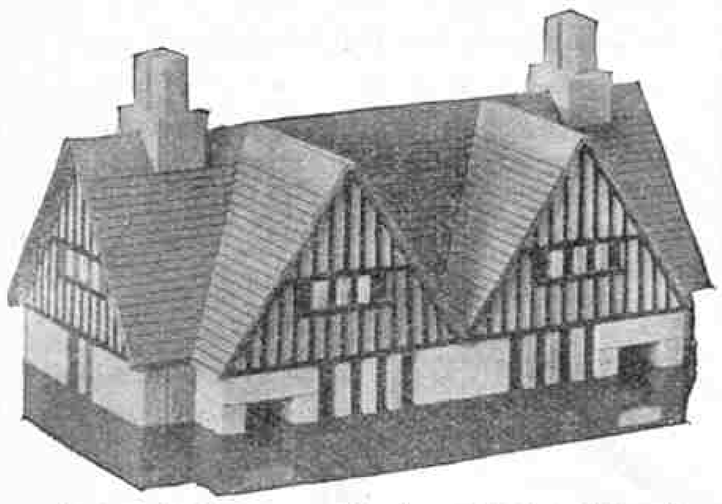

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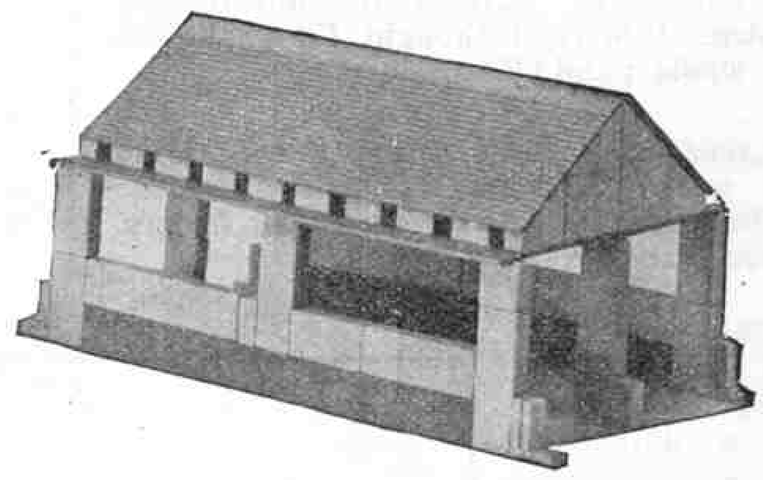

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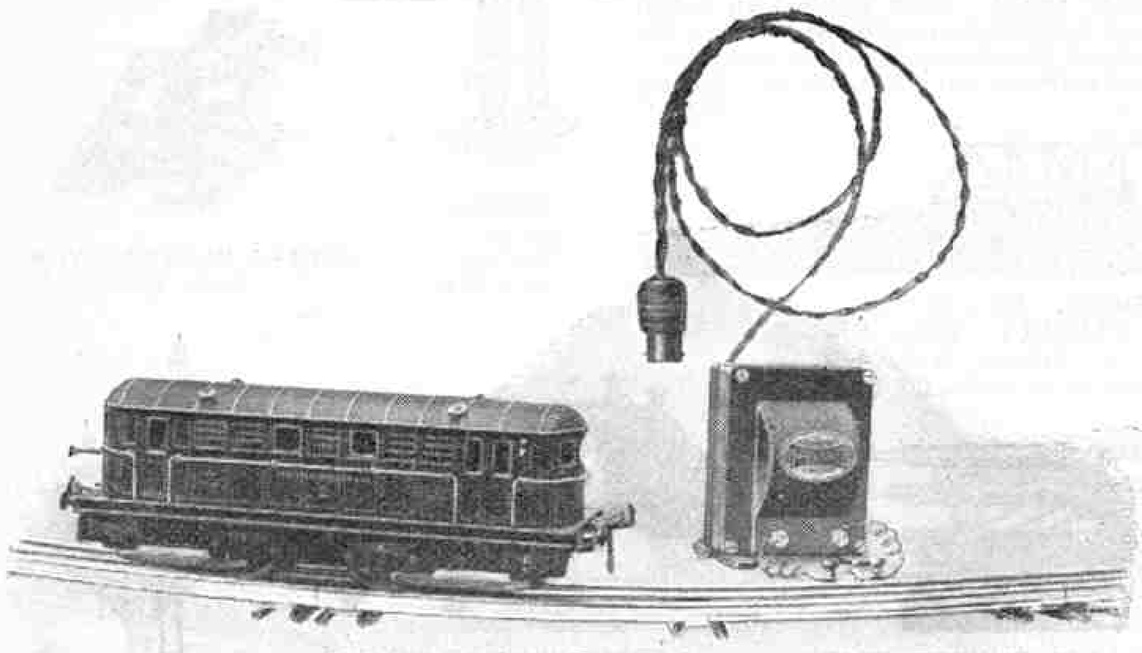

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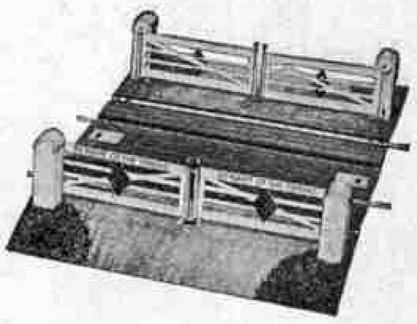

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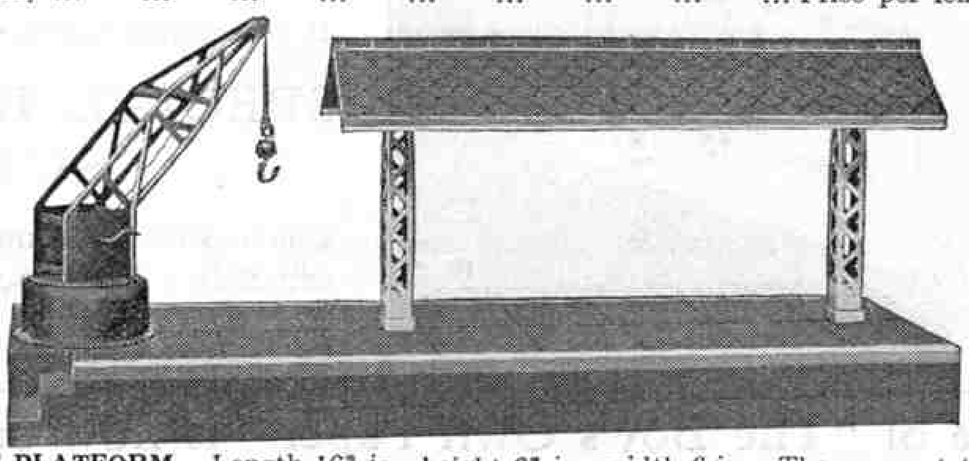
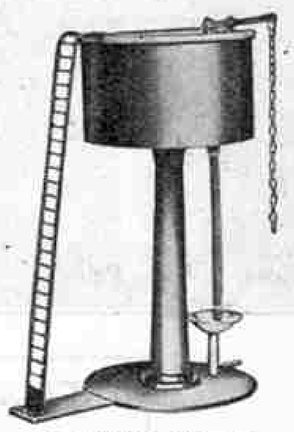


GOODS PLATFORM. Length 16¾-in., height 6¾-in., width 6-in. The crane at the end of the platform revolves on its base. It is enamelled in bright red and is fitted with a crank and ratchet mechanism for controlling the load. The remainder of the platform and shelter is coloured in green, blue and white ... ... Price **10/-**

ISLAND PLATFORM. Length 32½-in., height 6¾-in., width 3-in. The ramps at either end are detachable, and if desired the platform may be connected to the main station. Attractively coloured in green, blue and white ... ... Price **7/6**

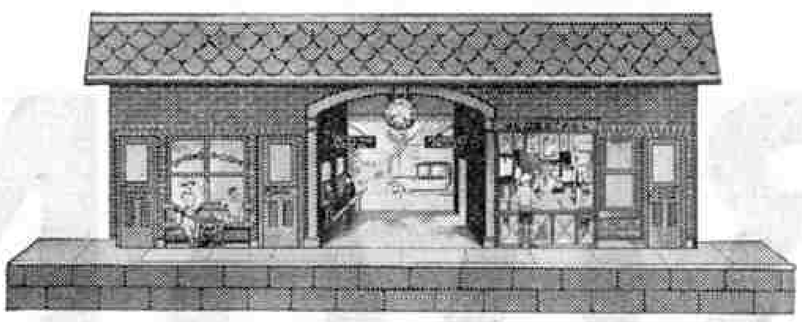
Ramps similar to those fitted to the Island Platform may be purchased separately. Price **9d.** each.

TELEGRAPH POLE
Price per pair **3/6**

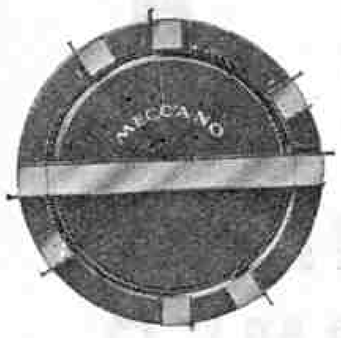


WATER TANK
Brightly coloured. Stands 8½-in. high. Fitted with flexible tube and valve lever.
Price **6/6**

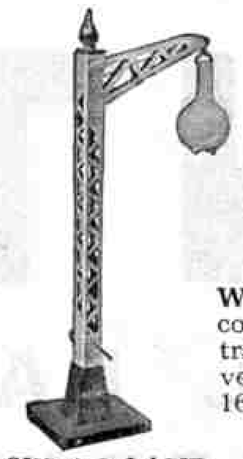
LOADING GAUGE
Price **1/9**



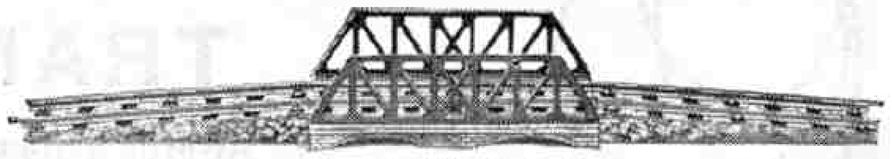
WAYSIDE STATION. A well-made model, richly finished in bright colours. By placing one or more of these Stations at intervals along the track, and using the Windsor Railway Station as the main terminus, a very realistic effect is given to a miniature lay-out. Dimensions: Length 16¾-in., width 6-in., height 9-in. ... ... Price **5/-**



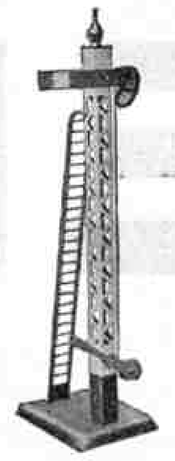
TURN-TABLE
Large Size ... Price **4/-**
Small Size ... ,, **2/6**



SINGLE LAMP STANDARD
A 4-volt bulb may be fitted into the globe. Price **3/-**

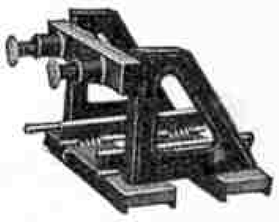


VIADUCT. Price **7/-**
ELECTRICAL VIADUCT. Price **8/-**
Centre Section for Viaduct. Price **4/6**
Centre Section for Electrical Viaduct. Price **5/-**

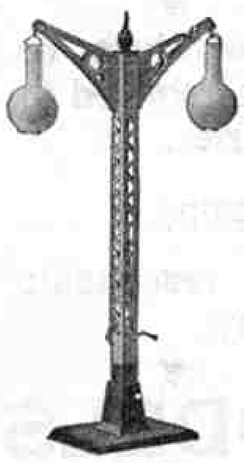


SIGNAL
"Home" or "Distant."
Price **2/6**

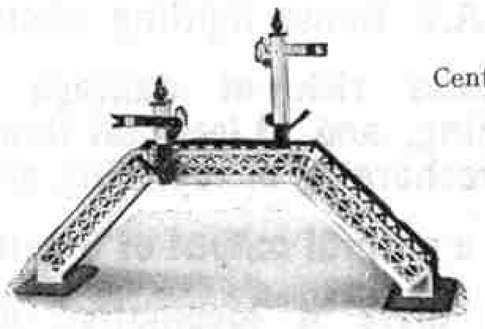
TUNNEL
Realistic and finished in colours ... Price **7/6**



SPRING BUFFER STOPS
Price **1/-**

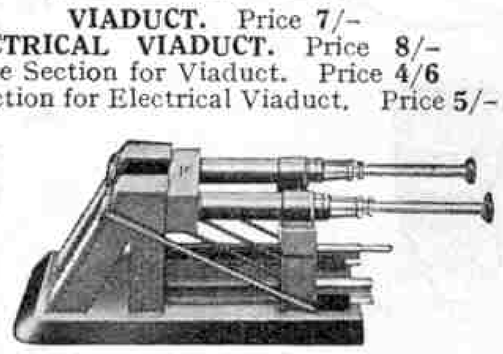


DOUBLE LAMP STANDARD
Four-volt bulbs may be fitted into the globes.
Price **4/-**



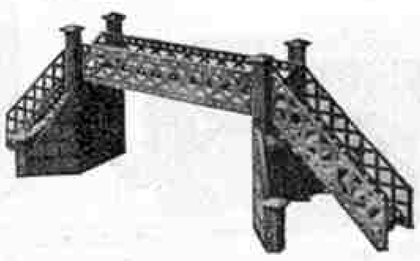
FOOTBRIDGE
No. 1. With detachable Signals Price **6/-**
No. 2. Without Signals ... ,, **3/6**
Signals only ... ... per pair **2/9**

PLATFORM ACCESSORIES
No. 1. Miniature Luggage.
Price per set **1/6**



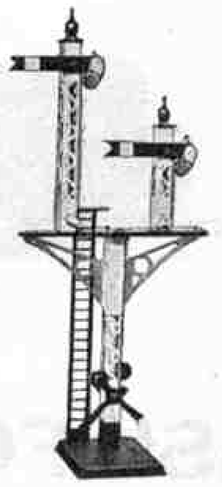
HYDRAULIC BUFFER STOPS
Price **5/-**

PLATFORM ACCESSORIES
No. 3. Platform Machines, etc. Price per set **1/6**



LATTICE GIRDER BRIDGE
Constructional type. Strong and well proportioned.
Price **9/6**

PLATFORM ACCESSORIES
No. 2. Milk Cans and Truck.
Price per set **1/6**



JUNCTION SIGNAL
Signal arms operated by levers at base. Very realistic model standing 14-in. in height.
Price **5/6**

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL

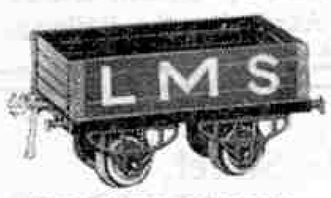
BRITISH AND GUARANTEED

ROLLING STOCK

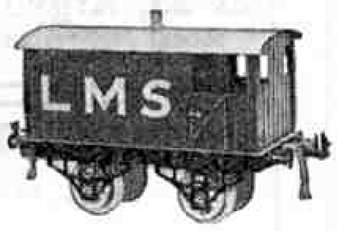
Gauge 0 **Hornby Series** Gauge 0

SEND FOR COMPLETE ILLUSTRATED LIST

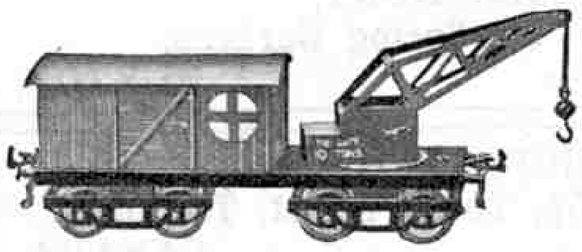
Below we illustrate 35 pieces of Rolling Stock of various types. These form part of the big range of components included in the Hornby Series. All Hornby Rolling Stock is modelled on realistic lines and is beautifully finished in colours. Each piece is available with either L.M.S., L.N.E.R. or G.W. lettering. Ask your dealer to show you the full range.



***HORNBY WAGON**
As supplied with all Hornby Goods Sets.
Price **2/6**

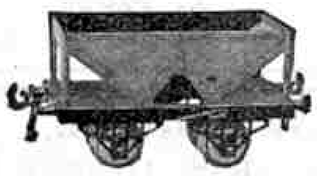


***BRAKE VAN**
Finished in grey, with opening doors. Price **3/6**

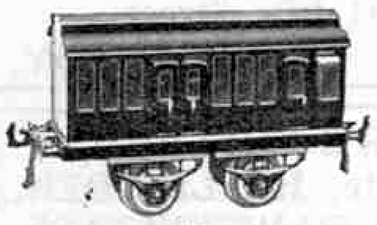


***BREAKDOWN VAN AND CRANE**
Beautifully coloured in grey and black, with opening doors. Suitable for 2-ft. radius rails only ... ... Price **6/3**

***BRAKE VAN**
Finished in grey, with opening doors. Price **3/6**

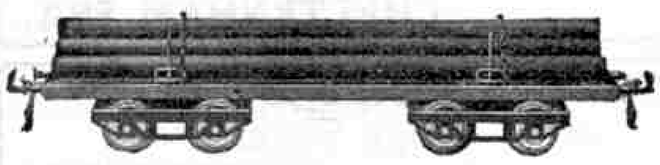


***HOPPER WAGON**
Mechanically unloaded. Finished in grey and black ... Price **4/–**



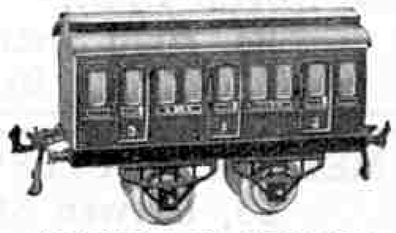
***GUARD'S VAN**
Realistic design, fitted each side with opening doors. Price **3/6**

WAGON
French type. Lettered Nord. Highly finished in colours.
Price **3/3**

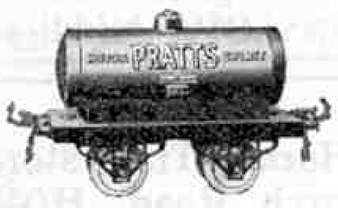


***No. 2 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport. Suitable for 2-ft. radius rails only.
Price **4/–**

MOTOR SPIRIT TANK WAGON, "B.P."
Finished in Yellow.
Price **2/6**

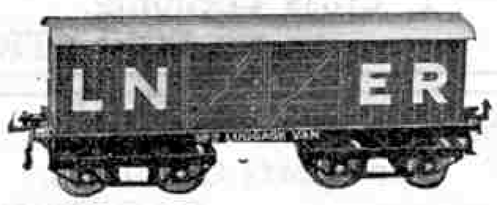


***HORNBY PASSENGER COACH**
As supplied with No. 0 and No. 1 Passenger Sets and No. 2 Tank Passenger Sets.
Price **3/6**

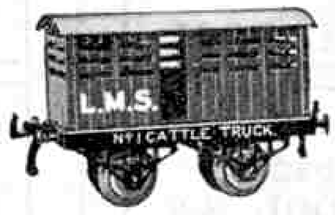


PETROL TANK WAGON "PRATTS"
Finished in green. Price **2/6**

***MILK TRAFFIC VAN**
Fitted with sliding door, complete with milk cans.
Price **3/6**

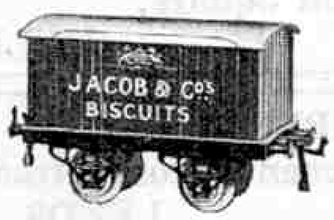


***No. 2 LUGGAGE VAN**
Finished in blue and green. Fitted with double doors. Suitable for 2-ft. radius rails only ... Price **5/9**



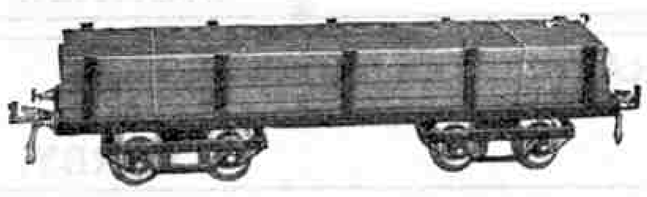
***No. 1 CATTLE TRUCK**
Fitted with sliding door. Very realistic design.
Price **3/6**

PETROL TANK WAGON "SHELL"
Finished in red. Price **2/6**



JACOB'S BISCUIT VAN
Finished in crimson lake, with opening doors.
Price **3/6**

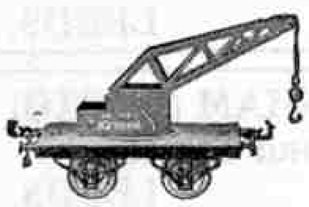
CARR'S BISCUIT VAN
Finished in dark blue, with opening doors.
Price **3/6**



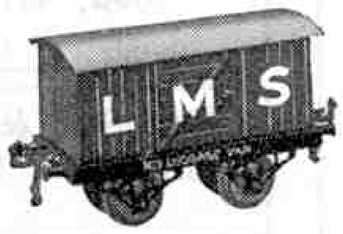
***No. 2 TIMBER WAGON**
Beautifully enamelled in green. Suitable for 2-ft. radius rails only ... ... Price **3/6**

SECCOTINE WAGON
Beautifully finished in blue, with opening doors.
Price **4/–**

CRAWFORD'S BISCUIT VAN
Finished in red, with opening doors. Price **3/6**



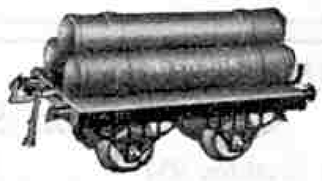
***CRANE TRUCK**
Finished in grey and black ... Price **3/6**



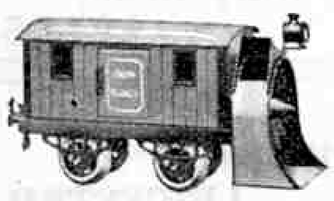
***No. 1 LUGGAGE VAN**
With opening doors.
Price **3/6**

***No. 2 CATTLE TRUCK**
Splendid model fitted with double doors. Suitable for 2-ft. radius rails only ... ... Price **5/9**

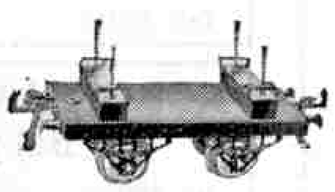
***GUNPOWDER VAN**
Finished in red, with opening doors. Price **3/9**



***GAS CYLINDER WAGON**
Finished in red, lettered gold. Price **2/6**

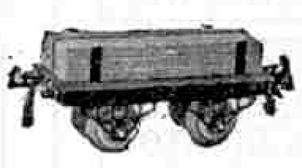


***SNOW PLOUGH**
With revolving plough driven from front axle.
Price **5/6**

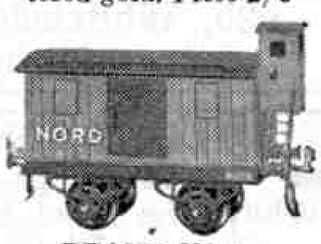


***No. 1 LUMBER WAGON**
Fitted with bolsters and stanchions for log transport.
Price **2/–**

***TROLLEY WAGON**
Finished in grey and red. Suitable for 2-ft. radius rails only ... Price **5/6**

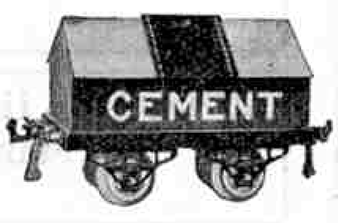


No. 1 TIMBER WAGON
Beautifully enamelled in green. Price **1/9**

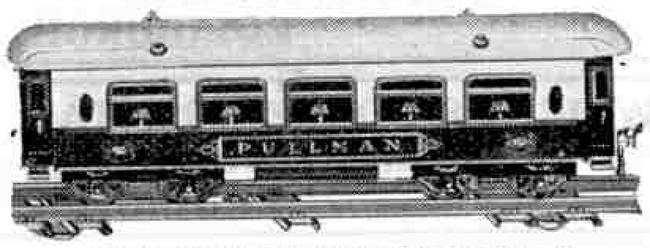


BRAKE VAN
French Type. Lettered Nord. Beautifully finished in colours. Opening doors.
Price **4/–**

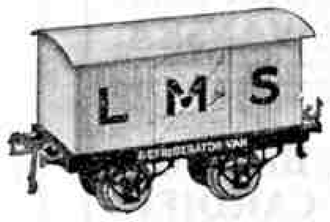
SIDE TIPPING WAGON
Excellent design and finish.
Price **2/6**



***CEMENT WAGON**
Finished in grey and black. Price **3/–**



HORNBY PULLMAN COACH No. 3
As supplied with No. 3 Train Sets
Price **16/6**



***REFRIGERATOR VAN**
Enamelled in white, with opening doors. Price **3/9**

ROTARY TIPPING WAGON
Finished in grey and green.
Price **3/–**

Lettered L.M.S., L.N.E.R. or G.W.

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

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19, Osmaston Road,
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CLYDE MODEL DOCKYARD,
22-23, Argyll Arcade, GLASGOW.
Model Makers to the Admiralty, the Railway Coys., etc.

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Grand Building, RAWTENSTALL.

H. POULTON, Toyland,
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HOBBIES LTD.,
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PEARSON & DENHAM (PHOTO) LTD., 6, Bond Street,
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A. WRIGHT, The Garage,
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Tel. 22719 **LEEDS.**

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"Baby's Kingdom,"
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Meccano & Hornby Train Supplies

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Tel. Central 2457 LONDON, S.E.

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269/271, Rye Lane,
Estab. in 1840 PECKHAM, S.E.15.

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42 & 44, Walworth Road,
Nr. ELEPHANT AND CASTLE, LONDON, S.E.17.

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H. G. PARTRIDGE & CO.,
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Telephone 165 City. MANCHESTER.

A. FRANKS LTD.,
95 & 97, Deansgate, MANCHESTER.
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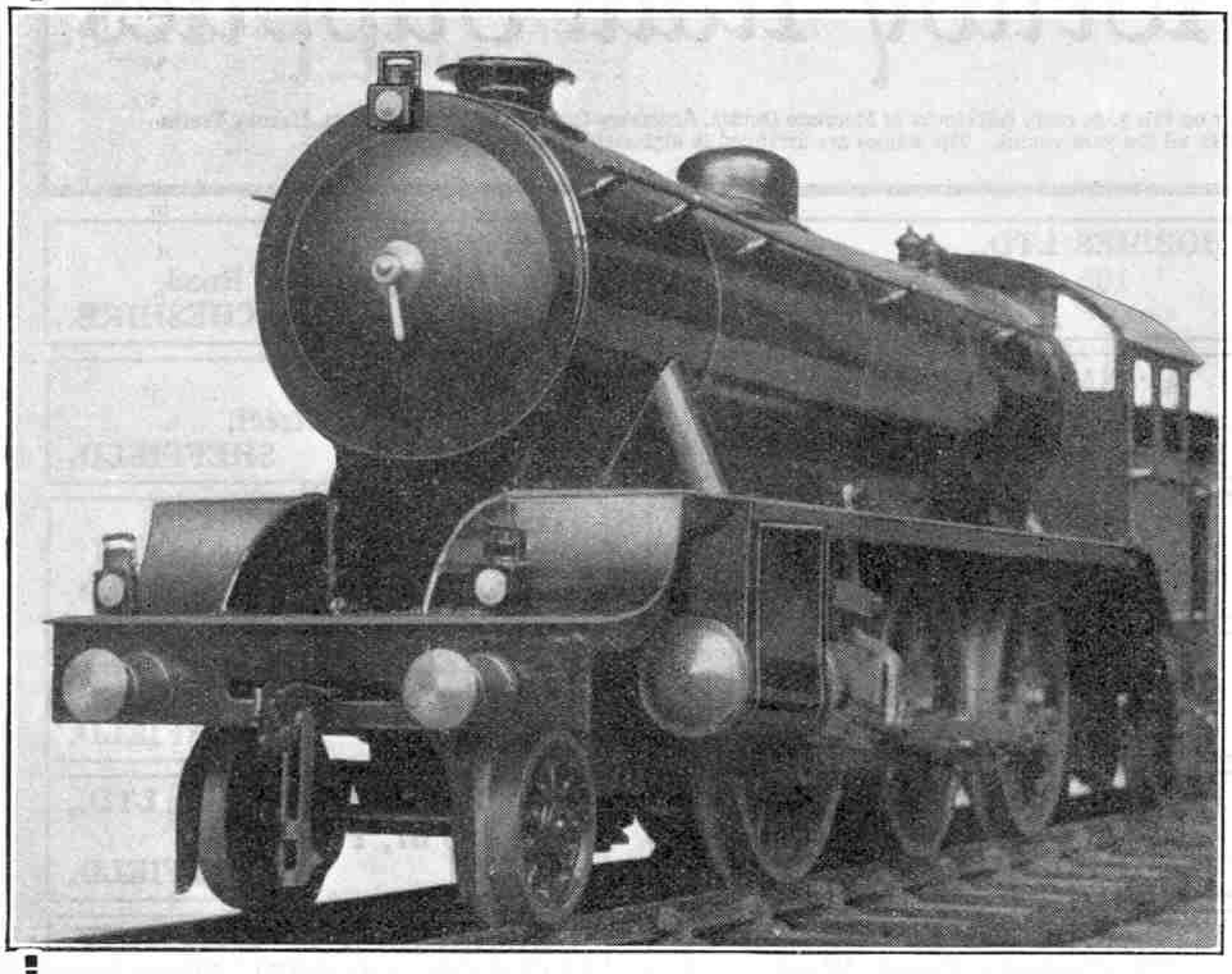

Untouched Photograph of our

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Piston valve cylinders with ground valves and rods of stainless steel. Modified Walschaert valve gear. Reversing from cab. Exhaust into chimney.

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Fittings include safety valve under dome, whistle and regulator in cab, spring buffers, and six-wheeled tender. Anti-friction axle boxes. Whole model hand-enamelled and finished in correct style.

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The Electric Model is fitted with our Standard "Permag" Motor geared into driving wheels by a four threaded worm. Spoon type spring collectors, voltage 8-10

Price of either model in 1¾″ gauge. Length 25″.

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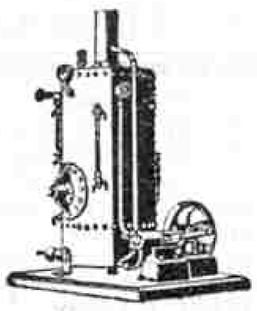

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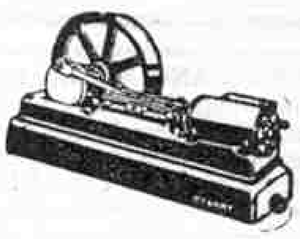

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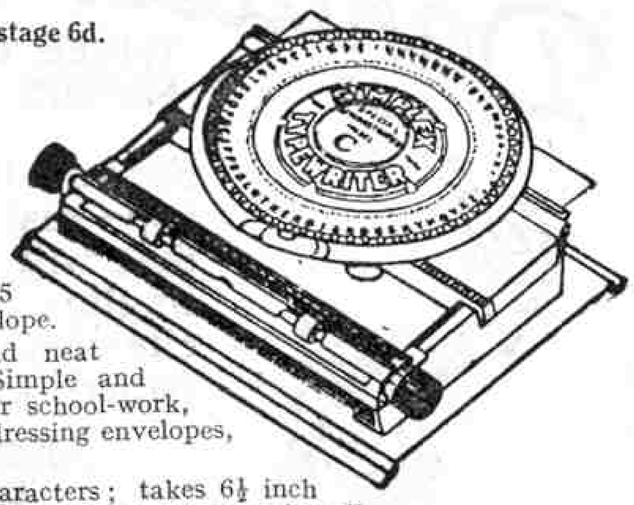

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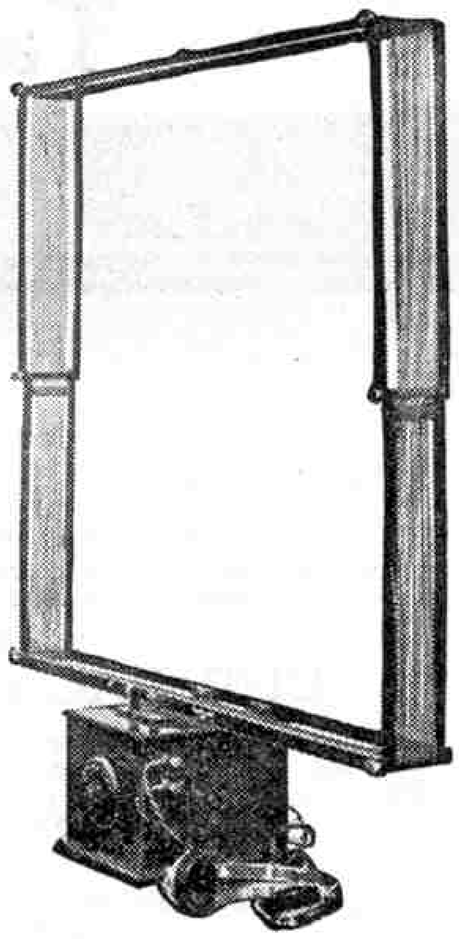

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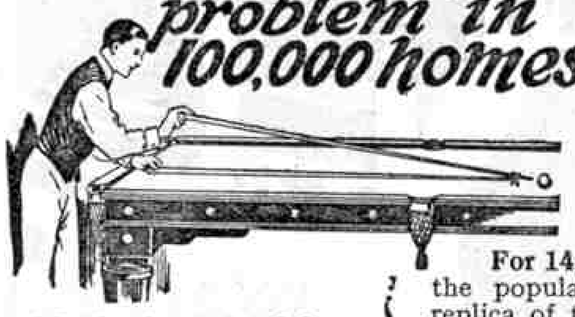

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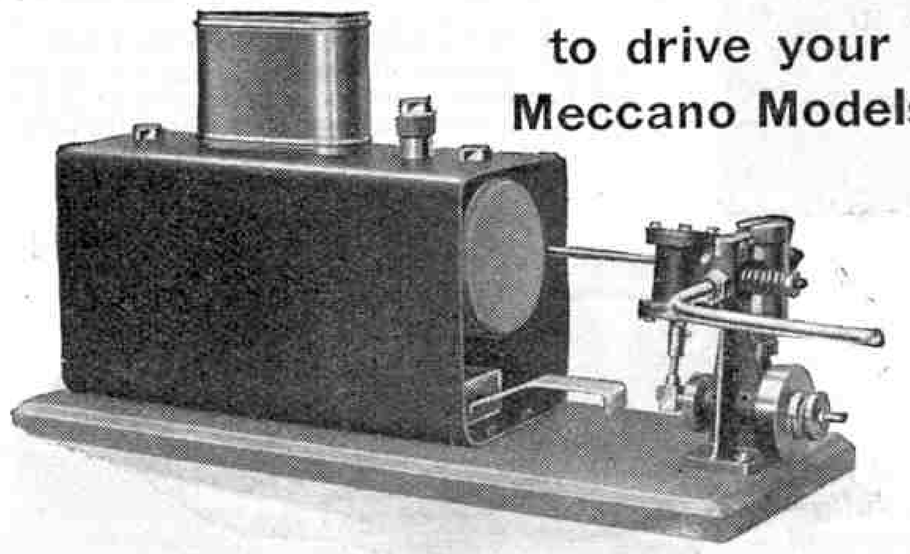
You must have the S.T. ENGINE

to drive your Meccano Models



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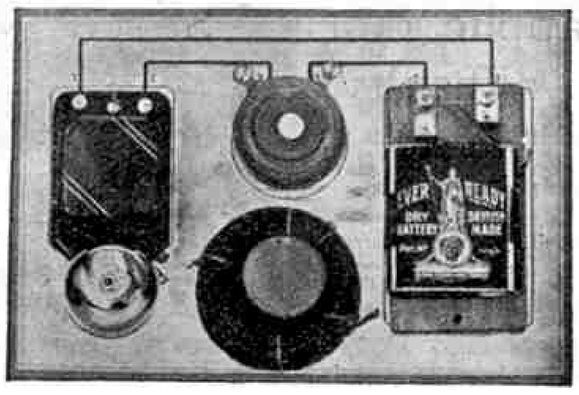

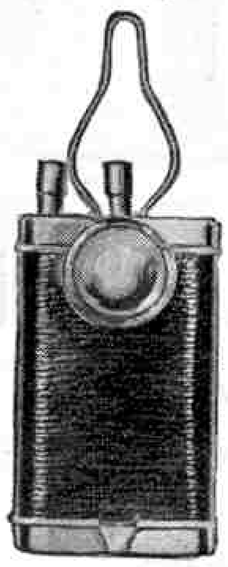

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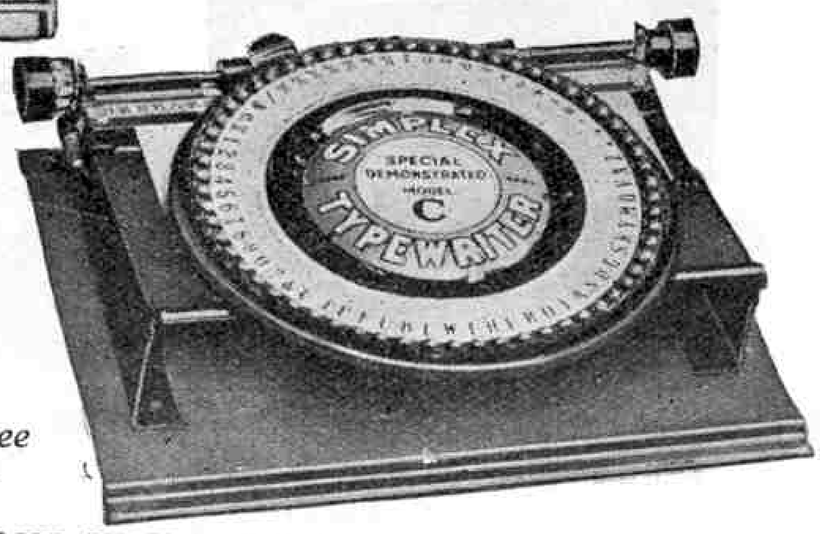

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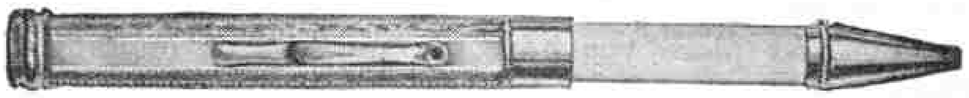

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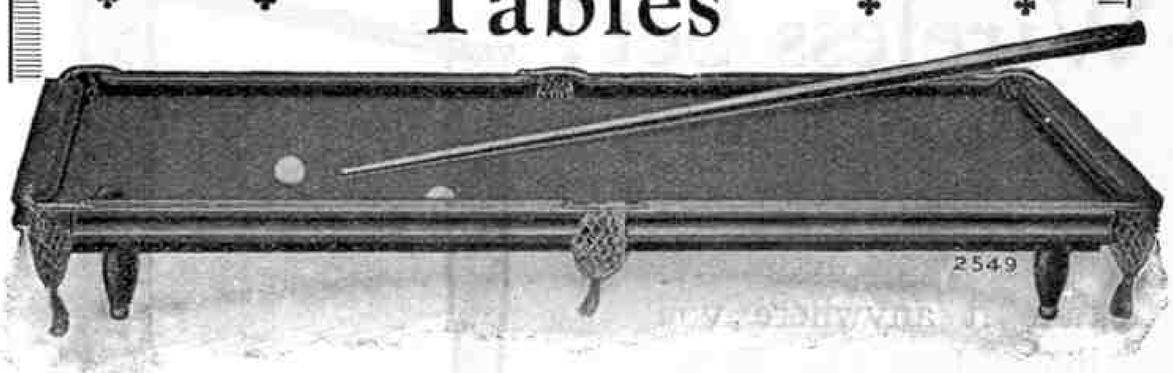

Size	Ball	Cue	Price
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Part carriage and packing **1/6** extra.

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to prevent them becoming loose, due to vibration. Previously there had been continuous trouble from these items working loose, but it was found that the application of SECCOTINE completely cured this difficulty.

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7/–	7/9	8/6	9/3	10/–

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20″	22″	24″	26″
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Colours :—Navy with Royal Blue and Saxe border.
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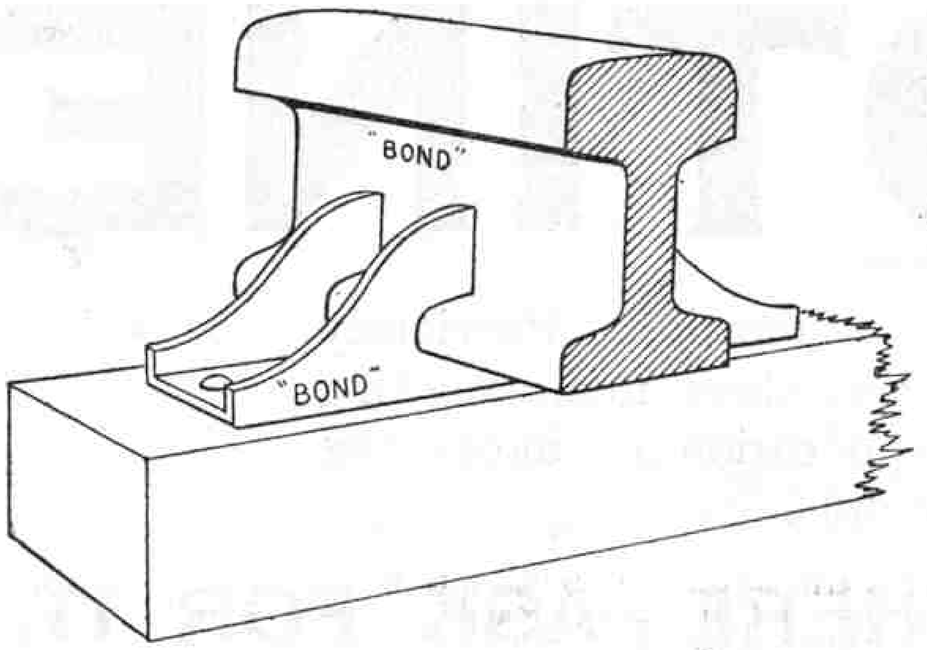

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Any item may be ordered by post and Kendals pay Carriage in Great Britain

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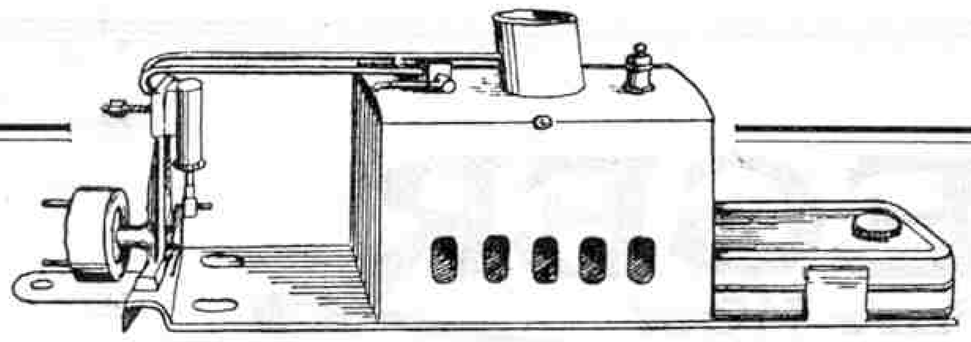

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make sure it is an F.Y.S.

because they are cheapest and best.

Ideal for driving your boat or stationary models.

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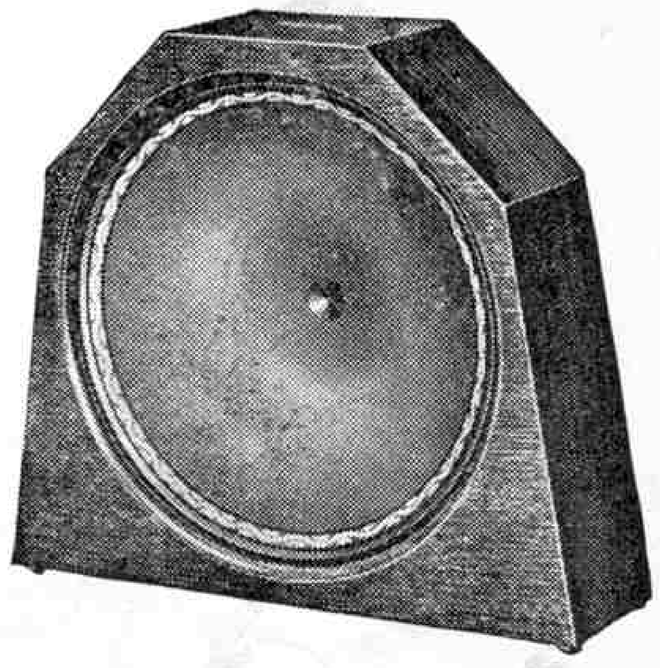

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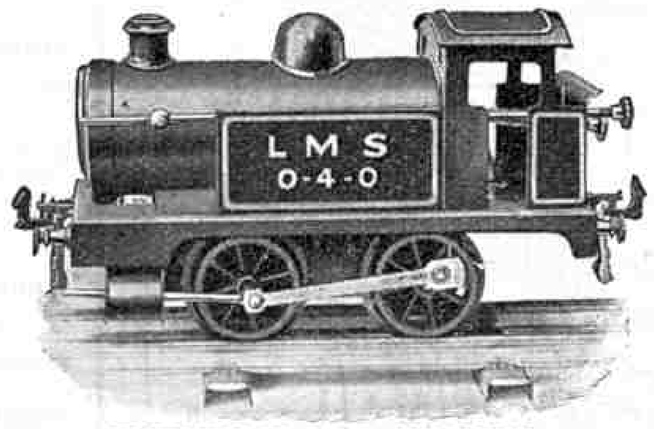

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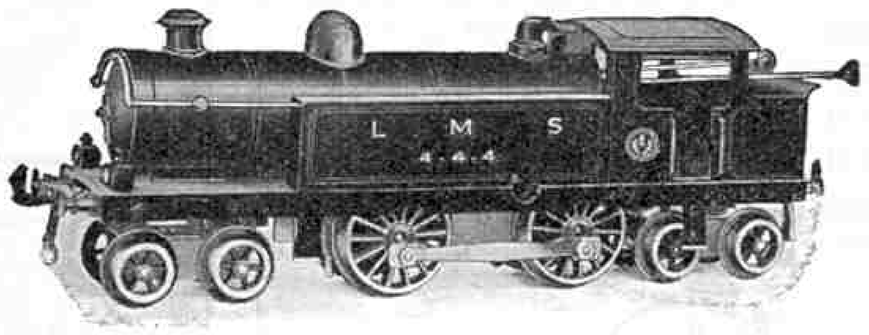

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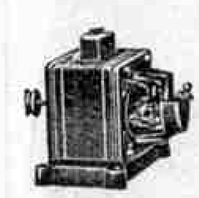

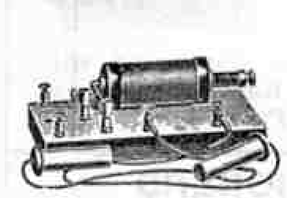

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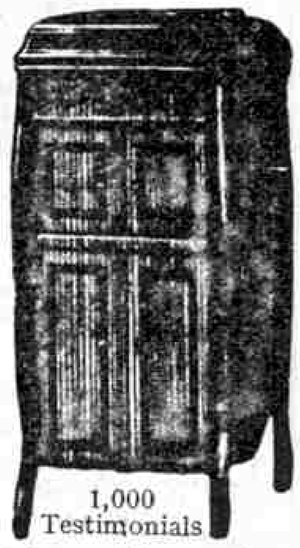

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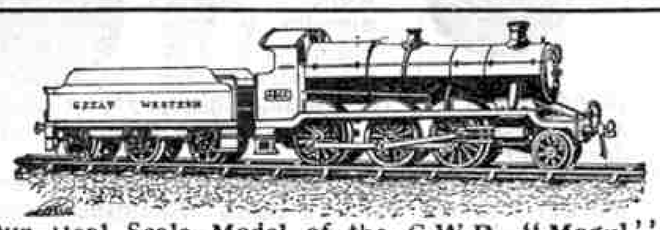

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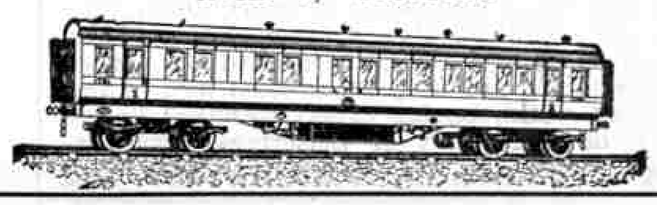

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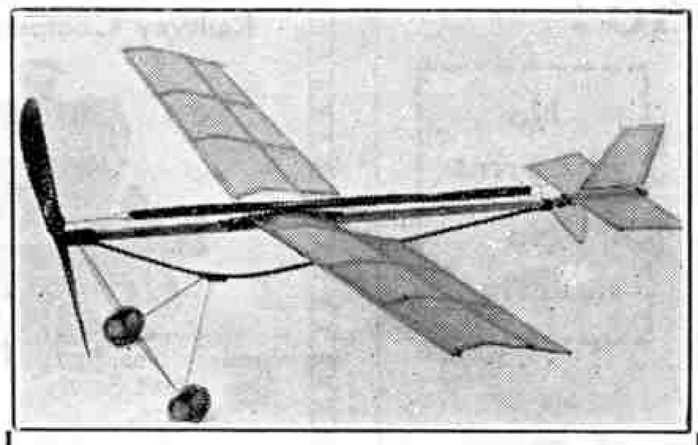

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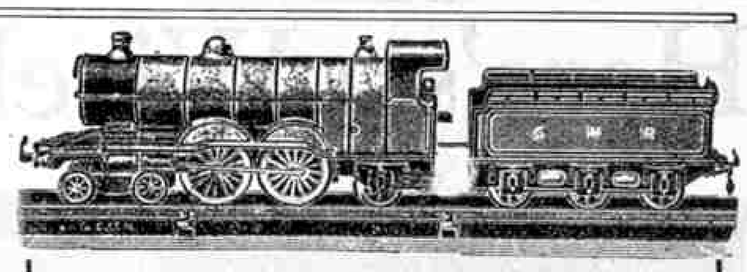

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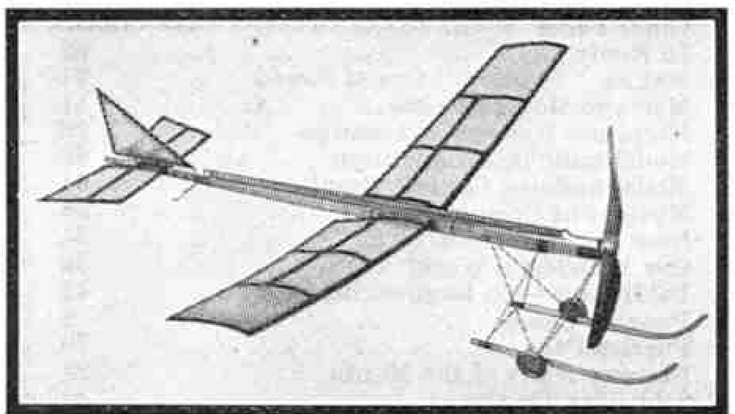

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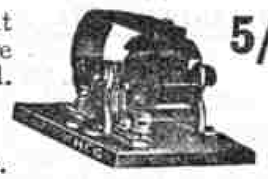

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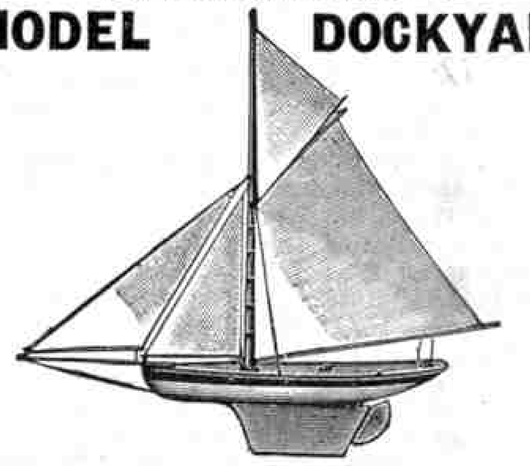

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EASTERN PACKET FREE.—Containing stamps from **China, Japan, Hongkong, Malay, Ceylon, India.** In all 100 different stamps to all applicants for my famous ½d. stamps on approval. Without approvals this packet may be had for 6d.—S. H. Fleming, St. Winifreds, Christleton Road, Chester.

50 DIFFERENT CANADA
Post Free 3/-
W. MERCER,
72, Frizzell Ave., Toronto, 6 Ontario, Canada.

FREE I offer **3 large pictorial** stamps of **Morocco.** They are **Airpost** Service, and
NOT CHEAP STAMPS
found in packets, but **really good used** stamps, showing **aeroplane** in **full flight** over seaport of Casablanca. **Finely printed** in **blue, green,** and **vermilion.** All I ask for them is **1½d. postage** (abroad 6d.) and a genuine request for my approvals. Prices are **NOT** put up to enable me to offer these free stamps.
H. LINDSEY, 27a, The Square, St. Annes-on-Sea.

THE ISLAND OF ASCENSION
One of England's smallest islands. A new set of these handsome pictorial stamps free of charge to bona fide applicants for selections of duplicates on approval. If 2d. is enclosed to cover postage a set of rare **British Solomon Islands** also given free of charge.
Special New Year Packet.—Attractively bound Stamp Album, 1,000 Stamp Hinges, and 200 used and unused Foreign Stamps, all different. Post free, 2/-. 500 different stamps, 1/9 post free.
HENRY TURNER,
110, Barnett Road, Preston, Brighton, Sussex.

MECCANO MAGAZINE

Registered at G.P.O., London, for transmission by Canadian Magazine Post.

EDITORIAL AND ADVERTISING OFFICES:—
BINNS ROAD, LIVERPOOL.

Telegrams: "Meccano, Liverpool."

Publication Date. The "*M.M.*" is published on the 1st of each month and may be ordered from any Meccano dealer, or from any bookstall or newsagent, price 6d. per copy. It will be mailed direct from this office, 4/- for six issues and 8/- for twelve issues.

To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

Advertisements

Readers' Sales and Wants. Private advertisements (i.e., not trade) are charged 1d. per word, minimum 1/-. Cash with order. Editorial and Advertising matters should not be dealt with on the same sheet of paper (see important notice below).

Small Advertisements. 1/- per line (average seven words to the line), or 10/- per inch (average 12 lines to the inch). Cash with order (see important notice below).

Display. Quotations for space bookings, and latest circulation figures, will be sent on request.

Press Day, etc. Copy should be sent as early in the month as possible for insertion in following issue. We usually close for press on or before 10th of each month for following issue. Half-tone blocks up to 100 screen.

Proofs of advertisements will be sent when possible for space bookings of not less than half-an-inch.

Voucher copies. Sent free to advertisers booking two inches or over. Other advertisers desiring vouchers should add 8d. to their remittance and should order voucher copy at same time.

Remittances. Postal Orders and Cheques should be made payable to Meccano Ltd.

Stamp Advertisers Please Note:—

The Readers' Sales and Wants column is reserved for advertisements dealing only with collections of stamps as a whole. A collection that is being disposed of on approval sheets, or by packets or sets, should be advertised in the small advertisement column, the rate for which is 1/- per line, average seven words to the line. Although the advertiser may not be actually conducting a stamp business, such advertisements are not to be classified under Readers' Sales and Wants.

Advertisers are asked to note that private advertisements of goods manufactured by Meccano Limited cannot be accepted.

Ordering the "*M.M.*" Overseas

Readers Overseas and in foreign countries may order the *Meccano Magazine* from regular Meccano dealers, or direct from this office. The price and subscription rates are as above, except in the case of Australia, where the price is 1/- per copy (postage extra), and the subscription rates 7/- for six months and 14/- for 12 months (post free).

IMPORTANT.

Overseas readers are reminded that the prices shown throughout the "*M.M.*" are those relating to the home market. Current Overseas Price Lists of Meccano Products will be mailed free on request to any of the undermentioned agencies. Prices of other goods advertised may be obtained direct from the firms concerned.

CANADA: Meccano Ltd., 45, Colborne Street, Toronto.
AUSTRALIA: Messrs. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W.
NEW ZEALAND: Models Ltd., Kingston & Federal Streets, Auckland.
SOUTH AFRICA: Mr. A. E. Harris (P.O. Box 1199), 142, Market Street, Johannesburg.

CUT THIS OUT

"MECCANO" PEN COUPON, VALUE 3d. Send 5 of these coupons with only **2/9** (and 2d. stamp) direct to the **FLEET PEN CO., 119, Fleet Street, E.C.4.** By return you will receive a handsome lever self-filling **FLEET S.F. PEN** with solid gold nib (fine, medium or broad), usually 10/6. Fleet price **4/-**, or with five coupons only **2/9.** De Luxe Model 2/- extra.

Enter 1928 Gamages

Start the New Year well with a visit to

THE BOYS STORE

This year the attractions of this magnificent store will be bigger and better than ever—which of course all British Boys will appreciate—hence a few suggestions appended below for the commencement of a record year.

Ask Dad to get this on easy terms

20/- deposit and 12 payments of 10/-

THE BABY CINE PROJECTOR

The ideal Home Cinematograph Projector. It gives a brilliant, sharp, flickerless picture. Takes reels of non-inflammable film. Works off the house lighting circuit, a resistance being incorporated in the base for all voltages of 105-115. Cash Price

£6 : 10 : 0

Send for List.

CHEMICAL CABINETS

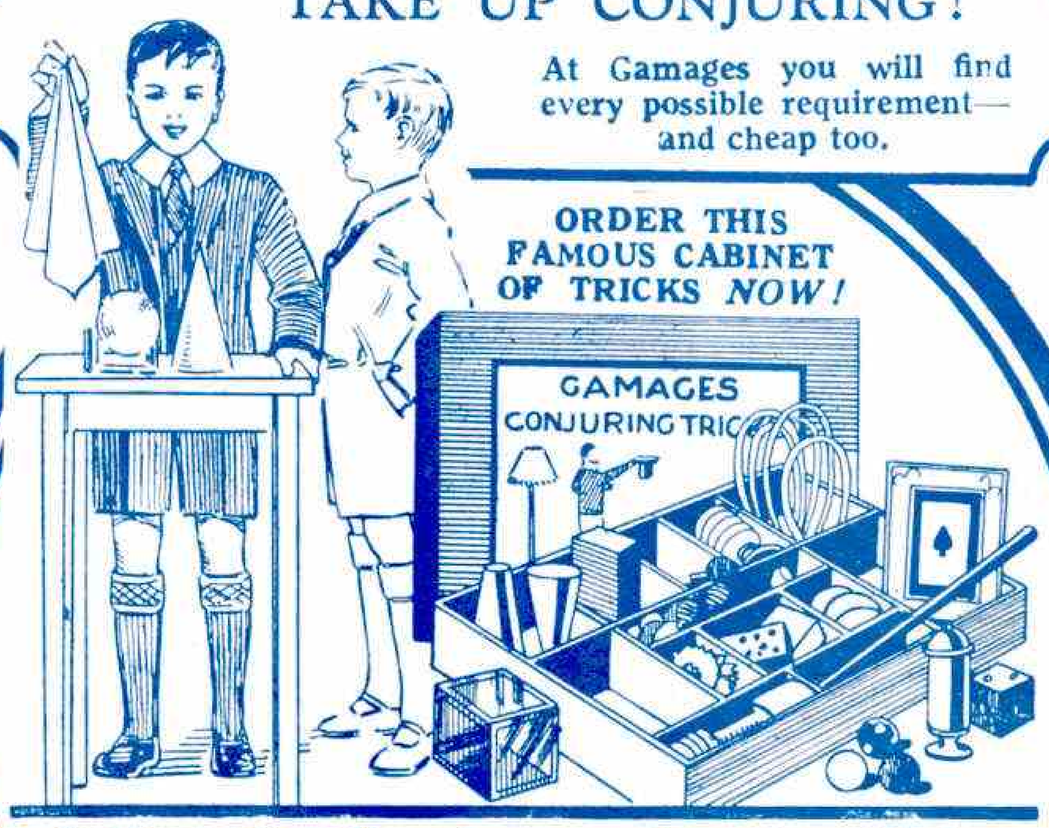
A fine Hobby for the long winter evenings and one of which you will not quickly tire. It is amusing, interesting, and very educational. The modern schoolboy will find it extremely useful for improving his knowledge. You have a choice of a large range of outfits if you come to Gamages.

5/6

Other Sets **3/3, 12/6, 32/6, 52/-**

TAKE UP CONJURING!

At Gamages you will find every possible requirement—and cheap too.



Conjuring is jolly good fun and ever so easy if you get your tricks from the right place and don't forget to practise. The fellow who can conjure gets a wonderful time. Not only does he get the fun of the conjuring, but also invitations to parties, fêtes, etc., that he would never get otherwise. All the apparatus and instructions for several mystifying tricks. Post 4d.

4/6

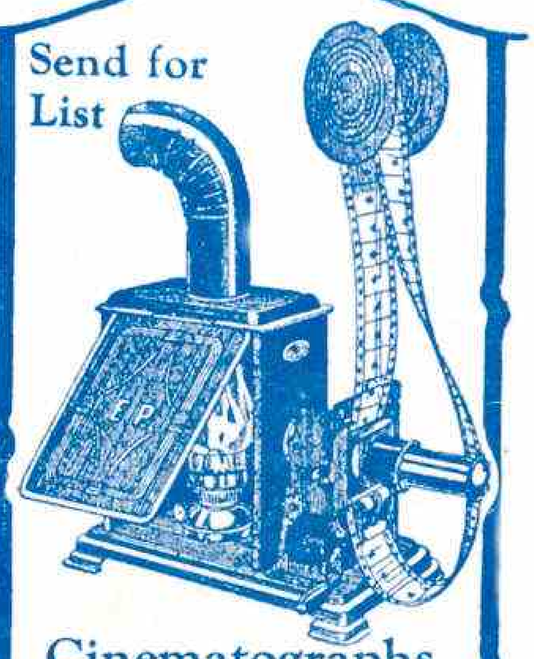
Other sets **3/-, 7/9, 10/9, 15/9, 22/6, 35/-, 42/-, 63/-**

FREE TO CONJURERS

A Fine Reproduction containing fully Illustrated Pages of the Latest Jokes, Tricks and Novelties. It is

Gamages Boy's Conjuring Catalogue Post Free on request.

Send for List



Cinematographs

Cinematographs with flywheel suitable for all standard size films. Complete with Film, Slide, and Oil Lamp. Height including Chimney, 7 in. Price complete

10/6

Extra Films, 36 ft., 1/-; 72 ft., 2/-. Long continuous coloured film bands, each 6d. and 1/-. Cheaper quality Cinematographs, each 5/6

The "Umaka" Clock Set

Comprises the complete set of finished parts, with simple instructions, enabling the novice to make A REAL CLOCK. Size 5½ in. Polished Wood Dial. Will go for years and keep good time. Interesting and instructive to all ages. Post free. Price

7/6

A. W. GAMAGE LTD., HOLBORN, LONDON, E.C. 1

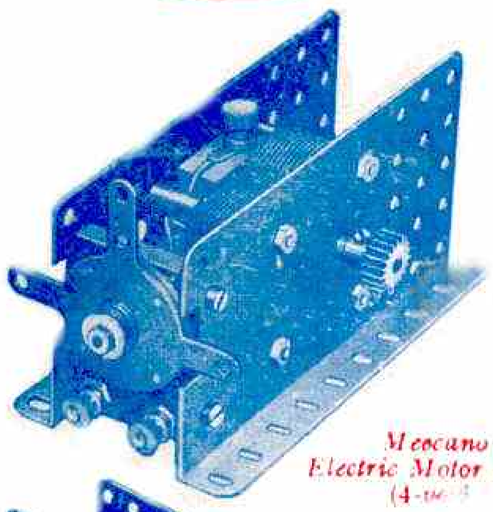
Run your Meccano models with Meccano Motors

RELIABLE — POWERFUL — SPECIALLY DESIGNED TO BUILD INTO THE MECCANO SYSTEM

If you wish to obtain the fullest possible enjoyment from the Meccano hobby you should operate your models with a Meccano Motor. Just imagine the thrill of setting in motion your Crane, Ship Coaler, Motor Car, Windmill or any other model you build. You push over the control lever of the Motor and immediately the model commences to work in exactly the same manner as its "big brother" in real life.

All Meccano Motors are strongly made and the utmost care is taken in their manufacture to ensure that they give every satisfaction to their owners.

Particulars and prices of the Motors and Accessories are given below.



Meccano Electric Motor No. 1 (4-volt)

Meccano Electric Motor No. 2 (100-250-volt A.C. or D.C.)

MECCANO CLOCKWORK MOTOR

This is a splendid piece of mechanism, simple, powerful, reliable and free from all danger. It is fitted with starting, stopping and reversing levers, and all its movements are fully explained in the instructions that accompany it. Price **7/6**

MECCANO ELECTRIC MOTOR No. 1

(4-volt)

The 4-volt Motor is specially designed to build into Meccano models. It may be run by a 4-volt accumulator or, by employing the Transformer described in the next column, from the main. Fitted with reversing motion, provided with stopping and starting controls, and the gearing is interchangeable.

Price **15/6**

MECCANO ELECTRIC MOTOR No. 2

(100-250-volt A.C. or D.C.)

This Electric Motor may be employed for any purpose for which a small motor is suitable, but it is specially adapted for driving Meccano models, into which it may be built. It is designed for connection with the electric light main—100-120-volts or 200-250-volts, alternating or direct. A 6 ft. length of flex, fitted with a plug for connection with the motor terminals and an adapter for connection with an ordinary lamp socket, is included. A suitable resistance is required when the motor is run with a 200-250-volt current, and this is supplied by connecting a 60-watt lamp in series with the motor. A board, on which are mounted a suitable lamp holder (lamp not included) and a switch, is provided separately.

Price **32/6**

Lamp board (with lamp holder and switch) Price 4/6

MECCANO RESISTANCE CONTROLLER

By employing this variable resistance the speed of the Meccano Electric Motor No. 1 (4-volt) may be regulated as desired. The controller is connected in series with the motor and accumulator, or with the motor and transformer if a transformer is used as the source of power. It will not regulate the speed of a high-voltage motor connected to the main. Price **3/6**

TRANSFORMER

By means of this transformer the Meccano Electric Motor No. 1 (4-volt) may be driven from the house supply (alternating current only). It is available for all standard supply voltages, from 100 to 250 inclusive, at all standard frequencies. The supply voltage and frequency must be specified when ordering. Price **30/-**

MECCANO ACCUMULATORS

These new and excellent types of accumulators have been adapted to drive the Meccano Electric Motor No. 1 (4-volt). They have remarkable recuperative powers, and will continue to supply current when nominally exhausted.

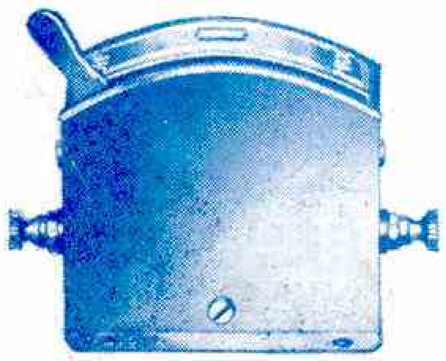
4-volt 8 amps Price **17/6** 4-volt 20 amps Price **25/-**

MECCANO RHEOSTAT

(For high voltage motors)

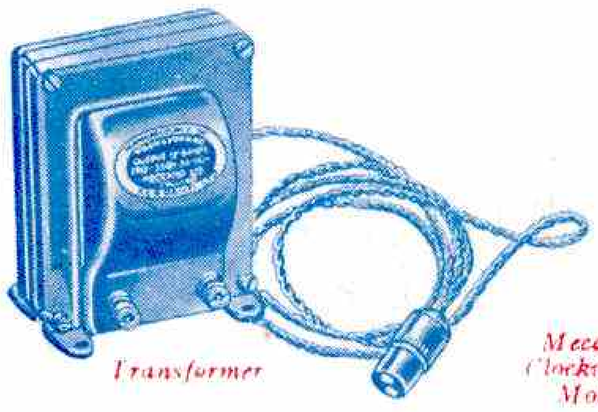
This Rheostat is for controlling the speed of the Meccano Electric Motor No. 2 or the H.V. Metropolitan Train. It may be connected to the house lighting system by means of an adapter and may be used with either alternating or direct currents ranging from 100 to 240 volts. A 60-watt lamp (not supplied) is required for use with the Rheostat.

Price **18/6**

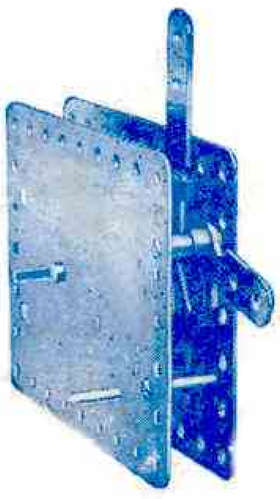


Meccano Resistance Controller

Meccano Rheostat



Transformer



Meccano Clockwork Motor

MECCANO LIMITED BINNS ROAD LIVERPOOL

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